The Society of the
Plastics Industry, Inc.

SPI

1986 edition

Facts & Figures of the U.S. Plastics Industry

SPI'S COMMITTEE ON RESIN STATISTICS

The Committee on Resin Statistics, only one of the more than thirty Operating Units within the Society of the Plastics Industry is composed of 100 representatives from plastics resin producing companies, trade publications, industry-related professional organizations, and various agencies of the Federal Government. All members of the Committee are quite knowledgeable of the rapidly growing plastics industry and have a special interest in the development of marketing and economic data.

The Committee is responsible for the development and maintenance of a monthly report on the major plastics materials. This report shows monthly and cumulative data on production and sales & use (including captive operations) with percent change from the previous year. It is the only detailed monthly report on plastics materials now available. There are over one hundred producers participating in the monthly program and they are believed to represent about 95% of total U.S. plastics production. Many of the materials covered reflect 100% industry coverage. The data are compiled by Ernst & Whinney, nationally renowned Independent Public Accountants.

The Committee is actively involved with the various departments of the Federal Government (International Trade Commission, Department of Commerce, Bureau of the Census, Bureau of Labor Statistics, etc.) assisting them in the development and improvement of the plastics segments of their special reports.

The Committee is also responsible for monitoring all resin data which appear in FACTS & FIGURES, thus assuring the most accurate and timely data available in the plastics Industry.

1986 edition

Facts & Figures of the U.S. Plastics Industry

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THE SOCIETY OF THE PLASTICS INDUSTRY, INC.

The Society of the Plastics Industry, Inc. is a member-run federation dedicated to promoting and protecting continuing growth for the plastics industry in the United States. The Society represents more than 1,800 member companies responsible for over 95 percent of plastics materials production.

SPI's 30 operating units and more than 300 committees have membership drawn from all segments of the industry—processors, resin and adjuvant suppliers, plastics distributors, machinery builders, and moldmakers. The Society serves as a federation of semi-autonomous, interrelated groups with a strong, common interest in the overall health of the plastics industry.

SPI serves as the "industry spokesman." It identifies and provides positive responses to misinformation and to potentially harmful regulations, bills, or court decisions by mobilizing pertinent facts and carrying out programs for timely and forceful action. At the same time, SPI works to prevent such damaging situations from occurring by building a positive understanding of the industry. The Society's service committees provide liaison with government agencies, code and regulatory groups, and many other associations.

SPI sponsors research projects in areas such as energy use, resource recovery, combustibility, and worker safety, at major private research organizations. The Society conducts numerous information programs, providing literature, surveys, reports, newsletters, and handbooks for industry and public use.

SPI sponsors one of the largest trade shows in the United States—the National Plastics Exposition, held every three years. The most recent show was held in June 1985, again at McCormick Place in Chicago.

Incorporated in 1937, SPI has grown with the dynamic industry it represents. In addition to the Society's headquarters office at 1025 Connecticut Ave. NW, Suite 409, Washington, D.C. 20036, SPI has four section offices: Eastern Office, 169 Union Boulevard, Totowa, NJ 07512; New England Office, 20 Speen Street, Framingham, MA 01701; Midwestern Offfice, 3150 Des Plaines Avenue, Des Plaines, IL 60018; and Western Office, Saddleback Square, Suite 124, 12440 Firestone Boulevard, Norwalk, CA 90650 plus a New York Office, 355 Lexington Ave., NY, NY 10017.

SPI draws together the diverse segments of the plastics industry into an effective organization that represents the entire industry.

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DEVELOPMENT OF TODAY'S PLASTICS

Today's plastics are one of the most used material on a volume basis in America's industrial and commercial life. The role of plastics is so broadly integrated in our own lifestyle that today there is virtually no product area where plastics do not make a major, irreplaceable contribution. Although the plastics industry in the United States is now in its second century, the most important developments have occurred since 1910. However, the roots of these modern developments go back not only to the research of cellulose nitrate by John Wesley Hyatt in the 1860's, but also to the plastic-like compositions used by man through the centuries.

ORIGIN OF PLASTICS

One can go as far back as the Old Testament to find references about natural materials used as fillers, adhesives, coatings, and the like. These materials were the precursors of what we call plastic materials today. Consequently, historians differ as to the exact date that the plastics industry began, and they will continue to do so since an exact year or even decade for the event is a matter of interpretation as to what constitutes a "plastic."

Certainly the history of the rubber industry has a bearing on plastics since ebonite, or hard rubber, discovered in 1851, was the first thermosetting material to be prepared and also the first material which involved a distinct chemical modification of a natural material. But ebonite was not exploited commercially for some years after its discovery and for that reason its historical importance has become somewhat blurred.

EUROPEAN DEVELOPMENTS

While the basic processes of rubber technology were developing, other important discoveries were taking place in Europe. Following work by Pelouze, Schonbein was able to establish conditions of controlled nitration of cellulose. The product soon became of interest as an explosive and in the manufacture of collodion, a cellulose solution in an alcohol-ether mixture. In the 1850's the English inventor Alexander Parkes observed that the solid residue left after the evaporation of the solvent of photographic collodion was a "hard, horny elastic and waterproof substance." In 1856 he patented the process of waterproofing woven fabrics by the use of such materials.

In 1862 the Great International Exhibition was held in London. It was there that Parkes introduced a new material named for himself—Parkesine. Parkesine was obtained by dissolving cellulose nitrate in a minimum of solvent. The mixture was then put on a heated rolling machine from which some of the solvent was then removed. While still in the plastic state the material was then shaped by dies or pressure. In 1866 Parkes organized the Parkesine Company to manufacture products from his new material, but the company failed in 1868. This appears in part due to Parkes' attempt to reduce production costs which resulted in the production of inferior items.

One year after the failure of the Parkesine Company, an associate of Parkes, Daniel Spill, formed the Xylonite Company to manufacture products similar to Parkesine. Once again economic failure resulted and Spill's company went bankrupt in 1874. Undaunted, Spill moved to a new site, established the Daniel Spill Company and continued production of his material, Xylonite.

FIRST PLASTICS IN THE U.S.

In the United States during the 1860's someone else was experimenting with cellulose nitrate—John Wesley Hyatt. In 1865 Hyatt became involved in devising a method for producing billiard balls from materials other than ivory. Originally using mixtures of cloth, ivory dust and shellac, in 1869 he patented the use of collodion for coating billiard balls. The patent came one year after his collodion material was introduced commercially.

John W. Hyatt and his brother Isaiah took out U.S. Patent 105,338 in 1870 for a process of producing a horn-like material using cellulose nitrate and camphor. Although Parkes and Spill had mentioned camphor in their work it was the Hyatt brothers who recognized the value of camphor as a plasticizer for cellulose nitrate. In 1872 the term celluloid was coined by Isaiah Hyatt to describe the Hyatts' commercially successful product.

The validity of Hyatts' patents was challenged by Spill and a number of court actions took place between 1877 and 1884. In the final action it was found that Spill had no claim on the Hyatt brothers, the judge ruling that the true inventor of the process was Parkes since he (Parkes) had mentioned the use of camphor in his patents. Thus, there was no restriction on the use of these processes and any company, including the Hyatts' Celluloid Manufacturing Company, were free to use them. After that decision the Celluloid Manufacturing Company prospered, changed its name to the American Celluloid Chemical Corporation, and eventually was absorbed by the Celanese Corporation.

FORMALDEHYDE RESINS

Next to cellulose nitrate the most important material in the early history of plastics was formaldehyde. Around 1897 there was a demand in German schools for a white chalkboard. Efforts to obtain such a product resulted in the discovery of casein plastics, produced by reacting casein (milk protein) with formaldehyde. The material soon became established under the trade names of Galalith and Erinoid, and today casein is still used by the button industry.

In 1899 Arthur Smith took out British Patent 16,274, the first dealing with phenol-formaldehyde resins, in this case for use as an ebonite substitute in electrical insulation. During the next decade the phenol-formaldehyde reaction was investigated mainly for academic interest. In 1907 however, Leo Hendrik Baekeland discovered techniques of so controlling and modifying the reaction that useful products could be made from it. Thus phenolics were the first fully synthetic resins to become commercially successful.

Prompted by the success of phenolic moldings, research began on reacting other materials, such as urea and thiourea, with formaldehyde. These materials were used in the manufacture of molding powders. Unlike the phenolics, they could be molded into light-colored articles and they rapidly achieved commercial success. Today these urea-based resins are used for molding powders, adhesives, and textile and paper finishing while the related melamine-formaldehyde resins are used in decorative laminates.

GROWTH OF MODERN PLASTICS

Cellulose acetate, a thermoplastic, was developed about the same time as the urea-based resins. Similar in structure to cellulose nitrate, it was found to be safer in processing and use. Cellulose acetate was introduced as a molding compound in 1927.

The period 1930-1940 saw the initial commercial development of today's major thermoplastics; polyvinyl chloride; low density polyethylene; polystyrene; and polymethyl methacrylate. The advent of the Second World War in 1939 brought plastics into great demand, largely as substitutes for materials in short supply, such as natural rubber. In the United States the crash program leading to large-scale production of synthetic rubbers resulted in extensive research into the chemistry of polymer formation, and eventually, to the development of more plastic materials.

The first decade after World War II saw the development of high density polyethylene and polypropylene and the growth of the newer plastics in many applications. Large-scale production of these materials reduced their cost dramatically. The new materials began to compete with the older plastics and even with the more traditional materials such as wood, paper, metal, glass and leather. Since that time the demand for plastics has increased steadily so that plastics are now accepted by designers and engineers as basic materials along with the more traditional materials. The automotive industry, for instance, relies on plastics to reduce weight and thus increase mileage.

INTRODUCTION OF PLASTICS RESINS

DATE	MATERIAL	EXAMPLE
1868	Cellulose Nitrate	Eye Glass Frames
1909	Phenol-Formaldehyde	Telephone Handset
1919	Casein	Knitting Needles
1926	Alkyd	Electrical Bases
1927	Cellulose Acetate	Tooth Brushes
1927	Polyvinyl Chloride	Wall Covering
1929	Urea-Formaldehyde	Lighting Fixtures
1935	Ethyl Cellulose	Flashlight Cases
1936	Acrylic	Brush Backs
1936	Polyvinyl Acetate	Flash Bulb Lining
1938	Cellulose Acetate Butyrate	Packaging
1938	Polystyrene	Housewares
1939	Nylon	Gears
1939	Polyvinylidene Chloride	Packaging Film
1939	Melamine-Formaldehyde	Tableware
1942	Unsaturated Polyester	Boat Hulls
1942	Low Density Polyethylene	Packaging
1943	Fluoropolymers	Industrial Gaskets
1943	Silicone	Motor Insulation
1945	Cellulose Propionate	Pens and Pencils
1947	Epoxy	Tools and Jigs
1948	Acrylonitrile-Butadiene-Styrene (ABS)	Luggage
1954	Styrene-Acrylonitrile (SAN)	Housewares
1954	Polyurethane	Foam Cushions
1956	Acetal	Automotive Parts
1957	High Density Polyethylene	Milk Bottles
1957	Polypropylene	Safety Helmets
1957	Polycarbonate	Appliance Parts
1959	Chlorinated Polyether	Valves and Fittings
1962	Phenoxy	Bottles
1964	Ionomer	Skin Packaging
1964	Polyphenylene Oxide	Battery Cases
1964	Polyimide	Bearings
1964	Ethylene-Vinyl Acetate	Adhesives and Coatings
1965	Polysulfone	Electrical/Electronic Parts
1970	Thermoplastic Polyester	Electrical/Electronic Parts
1973	Polybutylene	Piping
1973	Polyphenylene Sulfide	Telecommunications
1974	Polyethersulfone	Printed Circuit Boards
1975	Nitrile Barrier Resins	Non-food Packaging
1978	Linear Low Density Polyethylene	Extruded Film
1982	Polyetherimide	Electrical/Electronic Parts
1983	Polyetheretherketone	Wire and Cable
1984	Aromatic Copolyester	Electrical/Electronic Parts

1985 IN REVIEW—PRODUCTION AND SALES & CAPTIVE USE*

(in millions of pounds)

	PRODUCTION			SALES & CAPTIVE USE		
RESIN	1985	1984	%CHANGE	1985	1984	%CHANGE
Epoxy	385	406	- 5.2%	367	379	- 3.2%
Phenolic	2,621	2,502	4.8	2,640	2,510	5.2
Polyester	1,223	1,232	- 0.7	1,233	1,231	0.2
Urea	1,210	1,199	0.9	1,203	1,189	1.2
Melamine	192	210	- 8.6	194	197	- 1.5
Total Selected Thermosets	5,631	5,549	1.5	5,637	5,506	2.4
ABS	1,028	1,128	- 8.9	1,016	1,098	- 7.5
SAN	87	99	-12.1	84	88	- 4.5
HDPE	6,671	6,085	9.6	6,651	5,949	11.8
LDPE	8,889	8,413	5.7	8,790	8,416	4.4
Nylon	399	396	0.8	403	389	3.6
Polypropylene	5,139	4,940	4.0	5,275	4,816	9.5
Polystyrene	4,054	3,838	5.6	4,108	3,836	7.1
PVC	6,772	6,760	0.2	6,720	6,798	- 1.1
Thermoplastic Polyester	965	899	7.3	956	859	11.3
Total Selected Thermoplastics	34,004	32,558	4.4	34,003	32,249	5.4
Total Selected Plastics	39,635	38,107	4.0	39,640	37,755	5.0
All Other Plastics	6,231	6,229	0.0	5,700	5,572	2.3
Grand Total	45,866	44,336	3.5%	45,340	43,327	4.6%

* Excludes Polyurethane.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

1985 IN REVIEW* — DISTRIBUTION OF SALES & CAPTIVE USE BY MAJOR MARKET

(in millions of pounds)

				SHARE OF TOTAL	
MAJOR MARKET	1985	1984	% CHANGE	1985	1984
Transportation	1,989	2,109	- 5.7%	4.4%	4.9%
Packaging	12,774	12,398	3.0	28.2	28.6
Building/Construction	10,038	9,691	3.6	22.1	22.4
Electrical/Electronic	2,659	2,757	- 3.6	5.9	6.4
Furniture/Furnishings	2,107	2,117	- 0.5	4.7	4.9
Consumer/Institutional	3,975	3,986	- 0.3	8.8	9.2
Industrial/Machinery	364	400	- 9.0	0.8	0.8
Adhesives, Inks & Coatings	2,142	1,993	7.5	4.7	4.6
Other	5,122	4,080	25.5	11.2	9.4
Exports	4,170	3,796	9.9	9.2	8.8
Total	45,340	43,327	4.7%	100.0%	100.0%

*Excludes Polyurethane

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

TOTAL U.S. PRODUCTION AND SALES & CAPTIVE USE OF PLASTICS RESIN; 1960-1985

(in millions of pounds)

YEAR	PRODUCTION (Including) Polyurethane	SALES & CAPTIVE USE (Including) Polyurethane)
[a]1960	6,321	5,363
1961	6,930	6,040
1962	8,197	7,150
[b]1963	9,364	7,632
1964	10,525	8,847
1965	12,219	11,035
1966	14,199	11,726
1967	14,473	12,284
1968	17,231	15,396
1969	19,720	16,495
1970	20,056	17,494
[c]1971	21,161	19,813
1972	26,475	25,504
1973	29,213	28,719
1974	29,274	27,890
1975	22,828	22,278
1976	29,196	28,379
1977	33,948	32,771
1978	37,605	36,818
1979	41,577	40,607
1980	37,347	36,896
1981	39,867	38,801
1982	36,607	36,639
1983	42,777	42,212
1984	46,336	45,221
1985	47,946	47,470

[a] U.S. Tariff Commission data used for 1960-1970. May exclude some captive use.
[b] Cellulosics not included through 1962. Included beginning in 1963.
[c] SPI data used for 1971-1985.

Compound Growth Rate

Years	Total Production	Sales & Captive Use
1960-1985	8.4%	9.1%
1970-1985	6.0%	6.9%
1975-1985	7.7%	7.9%
1980-1985	5.1%	5.2%
1984-1985	3.5%	5.0%

TOTAL U.S. PLASTICS PRODUCTION AND SALES & CAPTIVE USE BY RESIN

(in millions of pounds)

	1976		1977		1978		1979		1980	
RESIN	**P**	**S & CU**	**P**	**S & CU**	**P**	**S & CU**	**P**	**S & CU**	**P**	**S & CU**
Epoxy	244	250	261	278	299	316	361	332	315	319
Phenolic	1,340	1,305	1,458	1,400	1,617	1,543	1,781	1,732	1,499	1,517
Polyester	1,042	959	1,061	1,045	1,209	1,199	1,147	1,152	947	949
Urea	821	809	963	951	1,122	1,103	1,367	1,355	1,165	1,147
Melamine	186	182	200	203	202	196	200	192	167	166
Total Selected Thermosets	3,633	3,505	3,943	3,877	4,449	4,357	4,856	4,763	4,093	4,098
ABS	988	925	1,069	1,057	1,134	1,118	1,191	1,183	920	916
SAN	113	104	115	113	120	121	124	126	111	103
HDPE	3,125	3,127	3,652	3,557	4,201	4,165	5,010	4,893	4,405	4,394
LDPE	5,813	5,765	6,471	6,488	7,111	7,147	7,793	7,815	7.291	7,467
Nylon	247	221	254	250	275	278	327	315	274	271
Polypropylene	2,632	2,536	2,747	2,698	3,074	3,055	3,841	3,894	3,648	3,714
Polystyrene	3,195	3,145	3,446	3,557	3,823	3,870	4,005	3,997	3,521	3,518
PVC	4,716	4,638	5,253	5,232	5,723	5,810	6,119	6,138	5,470	5,407
Thermoplastic Polyester	—	—	—	—	—	—	—	—	503	511
Total Selected Thermoplastics	20,829	20,461	23,007	22,952	25,461	25,564	28,410	28,361	26,143	26,301
Total Selected Plastics	24,462	23,966	26,950	26,829	29,910	29,921	33,266	33,124	30,236	30,399
All Other Plastics	4,734	4,413	6,998	5,942	7,695	6,897	8,311	7,483	7,111	6,497
Grand Total	29,196	28,379	33,948	32,771	37,605	36,818	41,577	40,607	37,347	36,896

P=Production S & CU=Sales & Captive Use

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

TOTAL U.S. PLASTICS PRODUCTION AND SALES & CAPTIVE USE BY RESIN (Cont'd)

(in millions of pounds)

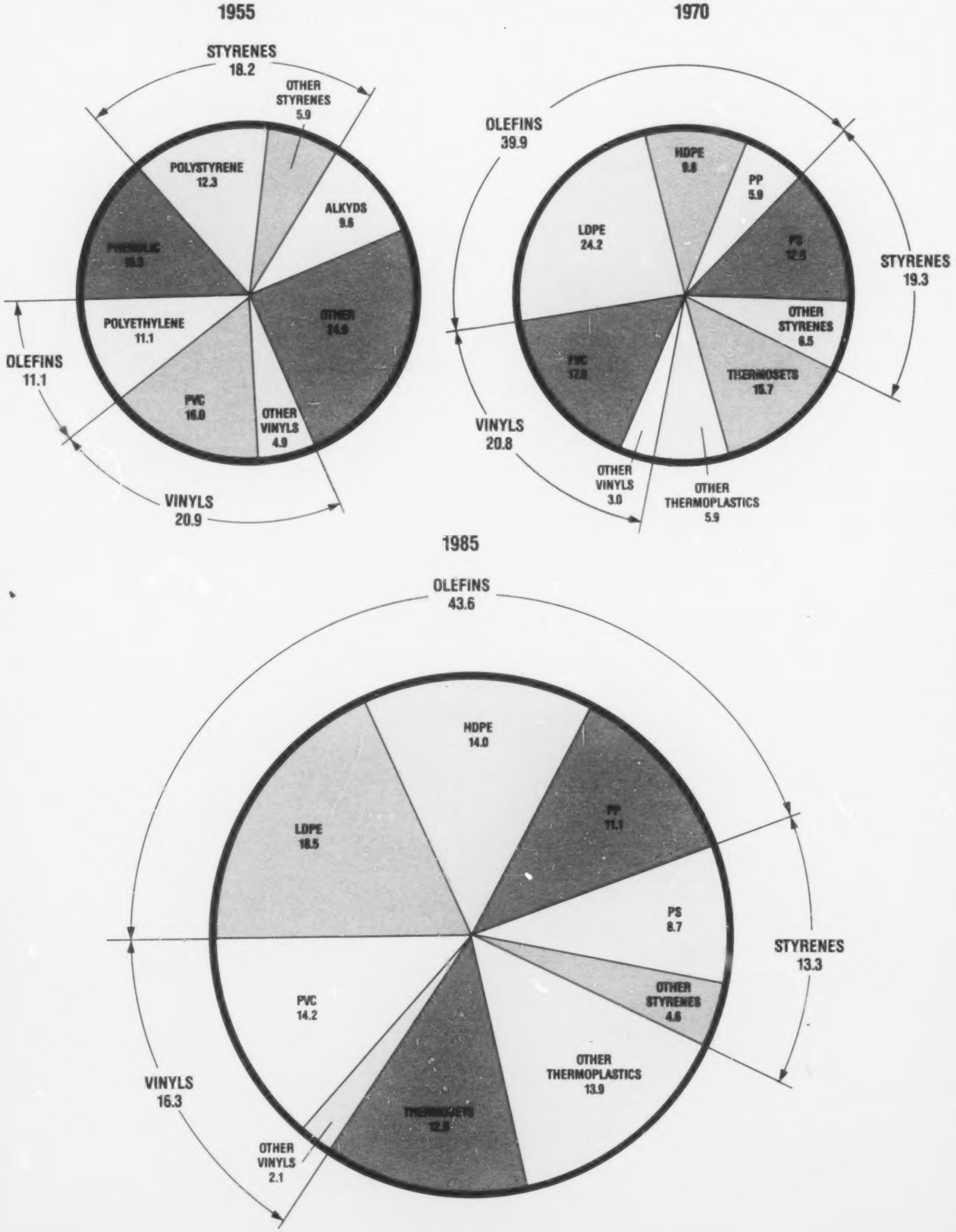
1981		1982		1983		1984		1985		Compound Growth Rate 1975-1985
P	S & CU	P	S & CU	P	S & CU	P	S & CU	P	S & CU	S & CU
336	332	286	301	334	331	406	379	385	367	7.0%
2,333	2,375	2,006	2,060	2,484	2,529	2,502	2,510	2,621	2,640	**
997	977	865	851	1,084	1,072	1,232	1,231	1,223	1,233	4.8
1,165	1,139	998	976	1,172	1,167	1,199	1,189	1,210	1,203	5.8
179	175	158	155	180	181	210	197	192	194	5.2
5,010	4,998	4,313	4,343	5,254	5,280	5,549	5,506	5,631	5,637	**
916	900	740	737	n.a.	n.a.	1,128	1,098	1,028	1,016	5.0
107	105	91	85	93	91	99	88	87	84	1.1
4,695	4,683	4,928	5,024	5,691	5,707	6,085	5,949	6,671	6,085	10.2
7,693	7,516	7,503	7,687	8,041	8,045	8,413	8,416	8,889	8,790	6.4
312	288	228	247	321	329	396	389	399	403	10.9
3,955	3,888	3,477	3,623	4,434	4,464	4,940	4,816	5,139	5,275	10.7
3,621	3,604	3,191	3,200	3,567	3,606	3,838	3,836	4,054	4,108	4.5
5,707	5,601	5,326	5,455	6,066	6,152	6,760	6,798	6,772	6,720	6.4
610	581	648	619	778	783	899	859	965	956	n.a.
27,616	27,166	26,132	26,677	28,991	29,177	32,558	32,249	34,004	34,003	7.8
32,626	32,164	30,445	31,020	34,245	34,457	38,107	37,755	39,635	39,640	7.7
7,241	6,637	6,162	5,619	8,532	7,755	8,229	7,466	8,311	7,830	8.5
39,867	38,801	36,607	36,639	42,777	42,212	46,336	45,221	47,946	47,470	7.6%

P=Production S & CU=Sales & Captive Use n.a.=not available.

**Not applicable since reporting on gross weight basis begun in 1981.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

PERCENTAGE DISTRIBUTION OF PLASTIC SALES & CAPTIVE USE BY MATERIAL



PLASTICS RESINS DOMESTIC MERCHANT SALES

(in millions of dollars and millions of pounds)

	1985		1984		% CHANGE	
RESIN	**Net Dollar Value**	**Quantity**	**Net Dollar Value**	**Quantity**	**Net Dollar Value**	**Quantity**
Low Density Polyethylene	$ 2,087	6,809	$ 2,438	6,593	– 14.4	3.3
Polyvinyl Chloride	1,543	6,055	1,806	5,800	– 14.6	4.4
High Density Polyethylene	1,540	5,516	1,660	5,028	– 7.2	9.7
Polystyrene	1,255	3,561	1,444	3,305	– 13.1	7.7
Polypropylene	1,197	3,406	1,228	3,242	– 2.5	5.1
ABS	743	913	804	996	– 7.6	– 8.3
Other Styrenes	685	978	652	912	5.1	7.2
Unsaturated Polyester	665	1,186	745	1,216	– 10.7	– 2.5
Thermoplastic Polyester	622	823	556	759	11.9	8.4
Nylon	541	356	521	338	3.8	5.3
Phenolic	502	2,346	413	1,528	21.6	53.5
Epoxy	415	307	473	338	– 12.3	– 9.2
Other Vinyls	251	208	256	197	– 2.0	5.6
Urea	188	1,063	197	1,074	– 4.6	– 1.0
Melamine	139	162	137	154	1.5	5.2
SAN	48	71	50	72	– 4.0	– 1.4
All other (excluding polyvinyl acetate and polyurethane	4,212	3,377	4,035	3,371	4.4	0.2
Total	$16,633	37,137	$17,139	34,923	– 3.0	6.3

Domestic merchant sales are quantities of sales excluding interplant transfers, captive consumption and exports.

Net dollar value represents the actual selling price after deductions for cash discounts, quantity discounts, returned goods and allowances, federal excise taxes, local taxes, and outgoing transportation (prepaid or otherwise) to warehouses or customers.

Source: SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

APPARENT U.S. CONSUMPTION OF SELECTED PLASTICS RESINS

Apparent consumption is calculated by adding imports to production then subtracting exports. It is an accurate measure of the quantity of material actually consumed in the United States.

For purposes of the table below, the production figures were taken from SPI's Monthly Statistical Report, as compiled by Ernst & Whinney. Both the import and export figures were taken from Bureau of the Census reports.

1985

(in millions of pounds)

RESIN	PRODUCTION	IMPORTS	EXPORTS	APPARENT CONSUMPTION
Low Density Polyethylene	8,892	484	1,020	8,356
Polyvinyl Chloride	6,772	379	240	6,911
High Density Polyethylene	6,671	38	798	5,911
Polypropylene	5,139	12	815	4,336
Polystyrene	4,054	28	102	3,980
Phenolic	2,621	35	34	2,622
Styrene Copolymers (inc. ABS)	2,123	108	138	2,093
Urea	1,210	21	7	1,224
Unsaturated Polyester	1,223	4	42	1,185
Thermoplastic Polyester[a]	965	16	170	811
Nylon	399	35	40	394
Epoxy	385	13	89	309
Melamine	192	2	14	180
Other Vinyls	190	30	43	177
Total of these resins	40,836	1,205	3,552	38,489
1984 Total	39,293	899	3,484	36,708
1983 Total	37,145	581	3,767	33,959
1982 Total	31,262	268	4,102	27,428
1981 Total	33,696	307	3,596	30,407
1980 Total	31,247	247	4,194	27,300
1979 Total	34,550	273	3,625	31,198
1978 Total	31,101	234	2,302	29,033
1977 Total	28,077	136	1,978	26,235
1976 Total	25,565	135	2,185	23,515

[a] Not included in total 1976–1979.

Source: Production—SPI Monthly Statistical Report, as compiled by Ernst & Whinney.
Imports—Bureau of the Census, IM 146
Exports—Bureau of the Census, EM 546

PLASTICS MATERIALS & RESINS
VALUE OF SHIPMENTS
(in millions of dollars)

VERSUS LARGEST CHEMICAL CATEGORIES	1981	1982	1983	1984	1985	COMPOUND GROWTH RATE 1980–1985
Industrial Organic Chemicals	38,500	30,400	33,250	36,950	38,900	2.3%
Drugs	22,300	24,700	27,400	29,950	32,500	10.3%
Plastics Materials & Resins	**16,700**	**15,800**	**18,900**	**20,800**	**21,600**	**7.7%**
Industrial Inorganic Chemicals	16,200	15,700	16,000	17,500	18,800	9.1%
Toilet Preparations	8,700	10,200	10,900	11,500	12,800	10.2%
Paints and Allied Products	9,100	9,150	10,200	11,700	12,600	8.6%
Soaps & Detergents	9,100	9,150	9,100	9,550	10,000	3.7%
Cyclic Crudes & Intermediates	8,000	7,100	7,400	8,200	8,400	2.1%
Fertilizers	8,000	7,300	6,900	8,000	8,100	0.4%
Polishes & Sanitation Goods	4,750	4,600	4,700	5,100	5,300	5.2%

VERSUS OTHER COMMODITIES	1981	1982	1983	1984	1985	COMPOUND GROWTH RATE 1980–1985
Steel Mill Products	69,000	46,000	45,000	53,000	53,900	– 2.3%
Paper and Board	32,000	30,900	32,800	39,000	38,000	5.7%
Cement and Concrete	17,950	16,700	18,000	20,600	22,350	4.4%
Plastics Materials & Resins	**16,700**	**15,800**	**18,900**	**20,800**	**21,600**	**7.7%**
Primary Aluminum	6,500	5,000	6,100	5,700	3,900	– 11.0%
Synthetic Rubber	3,000	3,100	3,100	3,300	3,100	3.2%
Primary Copper	5,400	3,000	3,500	3,100	2,900	– 11.9%
Leather Tanning & Finishing	1,900	1,800	1,900	2,000	1,700	– 2.6%

Source: Department of Commerce estimates.

PLASTICS MATERIALS & RESINS (SIC 2821)

(in millions of dollars except as noted)

	1982	1983	1984[1]	1985[2]	PERCENT CHANGE 1982-83	1983-85	1984-85
Industry data							
Value of shipments[4]	15,814	18,936	20,830	21,562	19.7	10.0	3.5
Value of shipments (1982$)	15,814	18,568	19,413	20,189	17.4	4.6	4.0
Total employment (000)	54.7	53.2	56.3	53.9	-2.7	5.8	-4.3
Production workers (000)	32.8	32.7	34.1	34.1	-0.3	4.2	0.0
Average hourly earnings ($)	11.73	12.84	13.51	14.25	9.5	5.2	5.5
Product data							
Value of shipments[5]	17,615	21,053	22,913	23,830	19.5	8.8	4.0
Value of shipments (1982$)	17,615	20,539	21,146	22,209	16.6	3.0	5.0
Shipments price index (1982 = 100)[6]	100.0	102.5	108.4	107.3	2.5	5.7	-1.0
Trade data							
Value of imports (ITA)[7]	268	469	668	775	75.0	42.4	16.1
Import/new supply ratio[8]	0.015	0.022	0.028	0.032	45.4	30.0	11.8
Value of exports	2,472	2,510	2,655	2,546	1.5	5.8	-4.1
Export/shipment ratio	0.140	0.119	0.116	0.107	-15.1	-2.8	-7.8

[1] Estimated except for exports and imports.
[2] Estimated.
[3] Forecast.
[4] Value of all products and services sold by the Plastics Materials and Resins industry.
[5] Value of products classified in the Plastics and Resins industry produced by all industries.
[6] Developed by the Office of Industry Assessment, ITA.
[7] Import data are developed by the chapter author.
[8] New supply is the sum of product shipments plus imports.

SOURCE: U.S. Department of Commerce: Bureau of the Census, Bureau of Economic Analysis, International Trade Administration, (ITA). Estimates and forecasts by ITA.

MISCELLANEOUS PLASTICS PRODUCTS (SIC 3079)

(in millions of dollars except as noted)

	1982	1983	1984[1]	1985[2]	PERCENT CHANGE 1982-83	1983-84	1984-85
Industry data							
Value of shipments[4]	37,009	40,398	45,050	46,850	9.2	11.5	4.0
Value of shipments (1982$)	37,009	39,712	42,900	44,200	7.3	8.0	3.0
Total employment (000)	479	486	546	571	1.5	12.3	4.5
Production workers (000)	368	376	426	442	1.9	13.5	3.7
Average hourly earnings ($)	6.99	7.16	7.47	7.76	2.6	4.2	3.9
Product data							
Value of shipments[5]	37,558	40,543	45,200	47,000	7.9	11.5	4.0
Value of shipments (1982$)	37,558	39,855	43,050	44,350	6.1	8.0	3.0
Shipments price index (1982 = 100)[6]	100.0	101.8	105.1	106.2	1.8	3.2	1.0
Trade data							
Value of imports (ITA)[7]	1,084	1,342	1,808	2,150	23.8	34.7	18.9
Value of exports (ITA)[8]	1,881	1,948	2,094	2,050	3.6	7.5	-2.1

[1] Estimated except for exports and imports.
[2] Estimated.
[3] Forecast.
[4] Value of all products and services sold by the Plastics Materials and Resins industry.
[5] Value of products classified in the Plastics and Resins industry produced by all industries.
[6] Developed by the Office of Industry Assessment, ITA.
[7] Import data are developed by the chapter author.
[8] Export data are developed by the chapter author.

SOURCE: U.S. Department of Commerce: Bureau of the Census, Bureau of Economic Analysis, International Trade Administration, (ITA). Estimates and forecasts by ITA.

GENERAL ECONOMIC STATISTICS

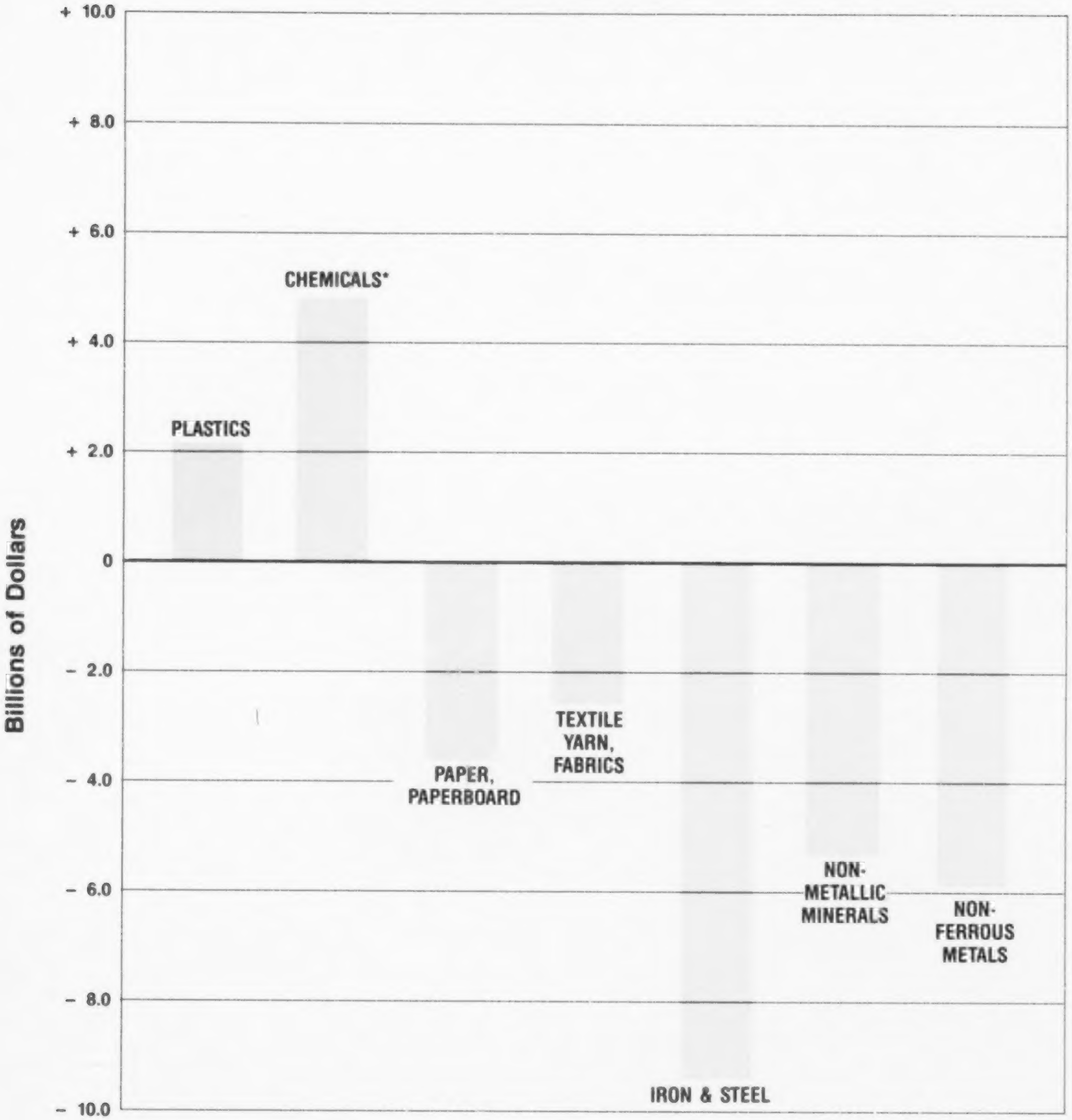
COMMODITY — BALANCE OF TRADE

(in millions of dollars)

	EXPORTS	IMPORTS	DIFFERENCE
Plastics Materials & Resins			
1981	3,809	779	+3,030
1982	3,650	766	+2,884
1983	3,732	1,098	+2,634
1984	4,050	1,477	+2,573
1985	3,777	1,619	+2,158
Chemicals (except plastics)			
1981	17,378	8,543	+8,835
1982	16,240	8,727	+7,513
1983	16,019	9,681	+6,338
1984	18,286	12,121	+6,165
1985	17,982	12,801	+5,181
Paper, Paperboard			
1981	2,961	3,822	− 861
1982	2,653	3,848	−1,195
1983	2,553	4,215	−1,662
1984	2,620	5,571	−2,951
1985	2,328	5,975	−3,647
Textile, Yarn, Fabrics			
1981	3,619	3,043	+ 576
1982	2,784	2,807	− 23
1983	2,368	3,225	− 857
1984	2,382	4,475	−2,093
1985	2,366	4,871	−2,505
Iron and Steel			
1981	2,880	11,238	−8,358
1982	1,804	4,487	−2,683
1983	1,478	6,791	−5,313
1984	1,348	10,844	−9,496
1985	1,234	10,217	−8,983
Nonmetallic Minerals, n.e.c.			
1981	2,194	4,890	−2,696
1982	2,168	9,612	−7,444
1983	1,770	5,330	−3,560
1984	1,865	6,889	−5,024
1985	1,821	7,391	−5,570
Nonferrous Metals			
1981	2,594	6,947	−4,353
1982	2,094	5,320	−3,226
1983	2,033	7,422	−5,389
1984	2,028	8,001	−5,973
1985	1,798	6,978	−5,180

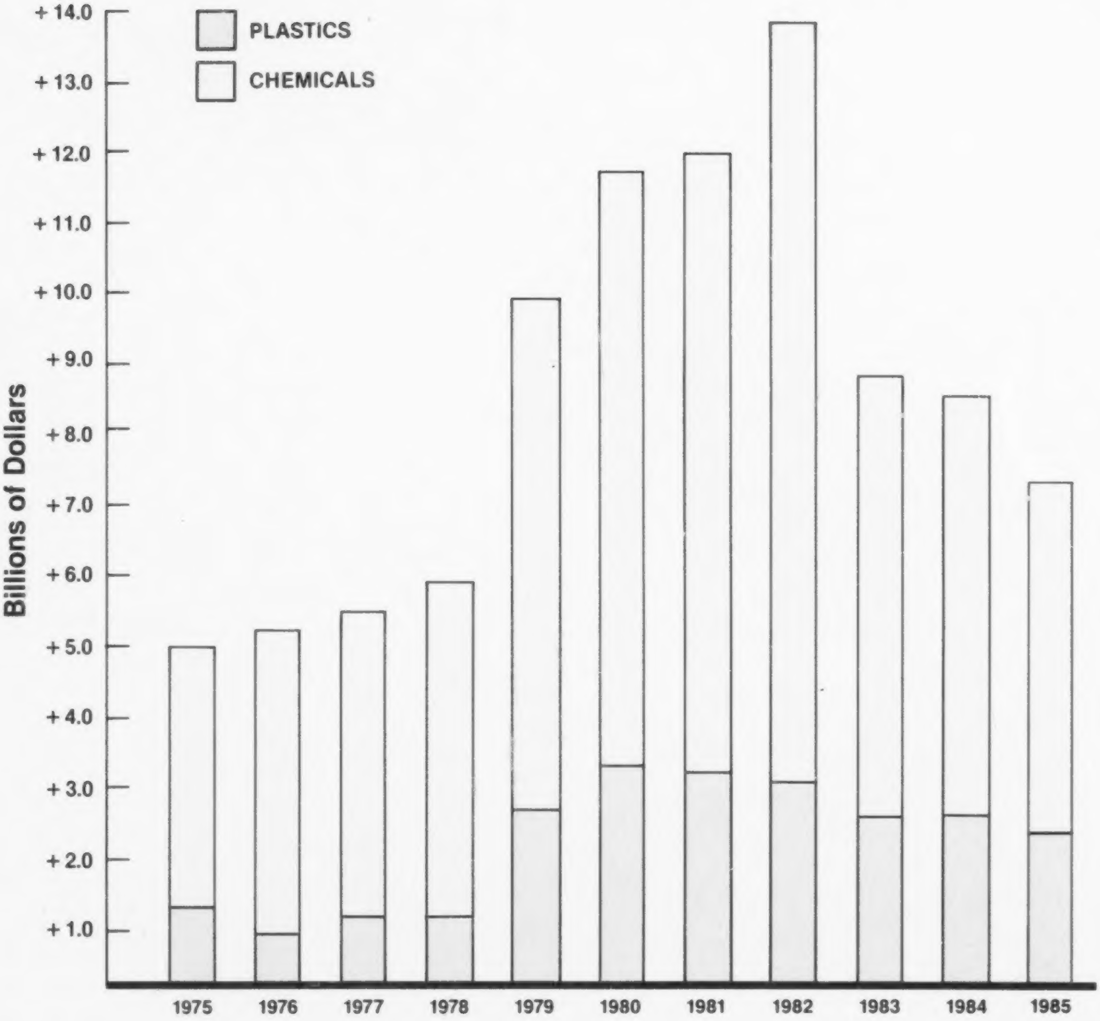
Source: U.S. Dept. of Commerce; FT 135(U.S. Imports), FT 410(U.S. Exports)

U.S. BALANCE OF TRADE—1985



Source: Department of Commerce
*Chemicals exclude plastics

PLASTICS & CHEMICALS BALANCE OF TRADE 1975-1985



PRODUCER PRICE INDEXES
[1967 = 100]

	COMMODITY GROUP					
YEAR	NON-METALLIC MINERAL PRODUCTS	METALS & METAL PRODUCTS	INDUSTRIAL COMMODITIES	CHEMICALS & ALLIED PRODUCTS	PLASTICS RESINS & MATERIALS	PULP, PAPER & ALLIED PRODUCTS
1968	103.7	102.6	102.5	99.8	91.9	101.1
1969	107.7	108.5	106.0	99.9	90.4	104.0
1970	113.3	116.7	110.0	102.2	90.7	108.2
1971	122.4	119.0	114.0	104.2	88.9	110.1
1972	126.1	123.5	117.9	104.2	88.7	113.4
1973	130.2	132.8	125.9	110.0	92.1	122.1
1974	153.2	171.9	153.8	146.8	143.8	151.7
1975	174.0	185.6	171.5	181.3	180.9	170.4
1976	186.3	195.9	182.4	187.2	194.0	179.4
1977	200.5	209.0	195.1	192.8	197.5	186.4
1978	228.8	227.1	209.4	198.8	199.9	195.6
1979	248.6	259.3	236.5	222.3	235.9	219.0
1980	282.9	286.4	274.3	260.3	279.5	249.2
1981	309.5	300.4	304.1	287.7	289.2	273.8
1982	318.6	302.0	312.4	292.3	283.3	288.7
1983	325.3	307.1	315.8	292.9	290.2	297.7
1984	337.2	316.0	310.3	300.9	308.5	318.2
1985	347.7	314.9	323.9	302.9	304.5	327.3

Source: Dept. of Labor, Bureau of Labor Statistics

PROFILE OF 50 BIGGEST MANUFACTURING INDUSTRIES

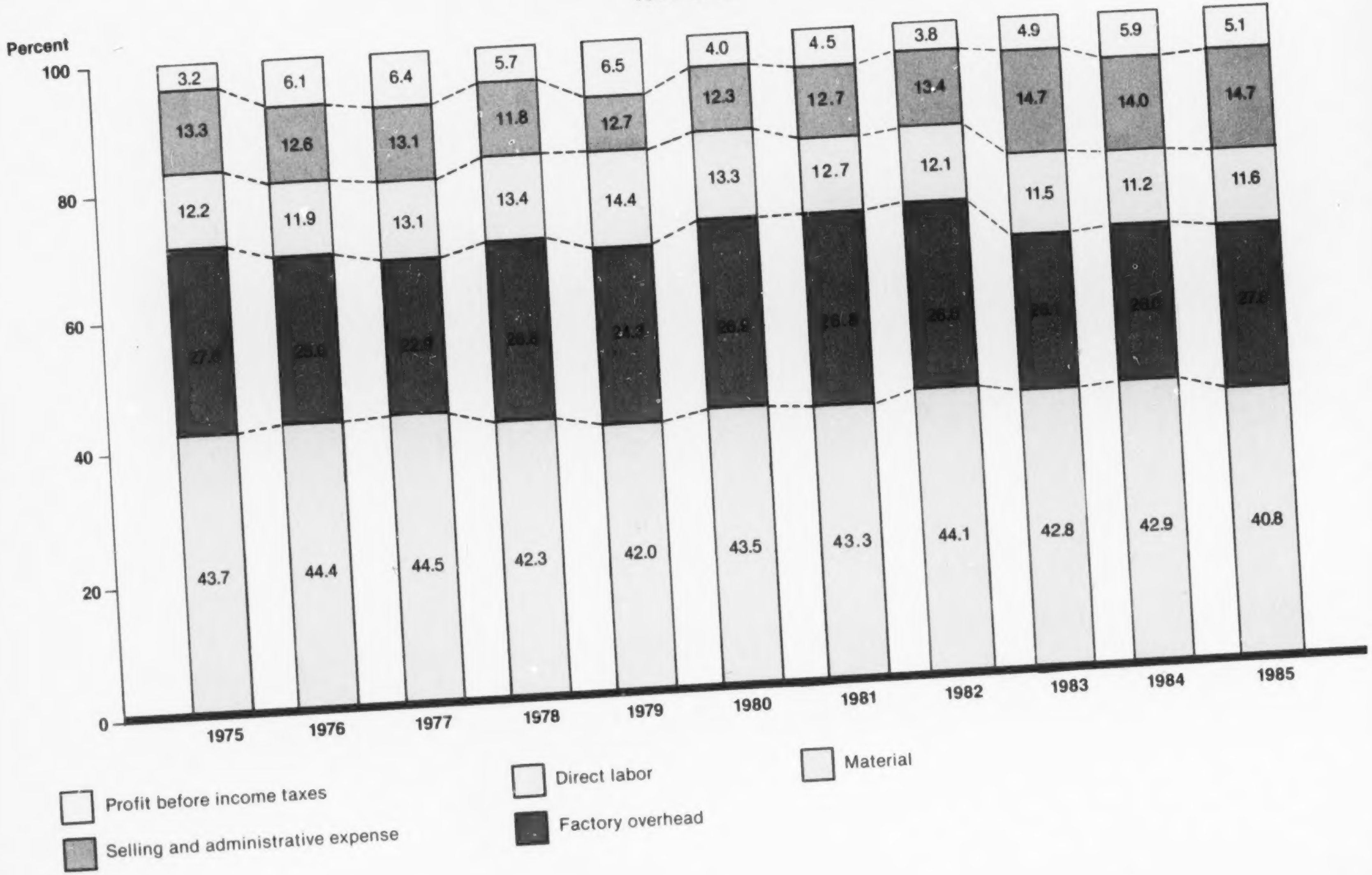
1985 RANK	SIC	INDUSTRY	1985 SHIPMENTS ($ MIL.)	TOTAL PLANTS	AVERAGE SHIPMENTS PER PLANT ($000)
1	2911	Petroleum refining	$172,494	321	$537,364
2	3711	Motor vehicles & car bodies	84,959	166	511,806
3	3573	Electronic computing equipment	51,917	1,149	45,184
4	2011	Meat-packing plants	50,125	873	57,417
5	3714	Motor vehicle parts & accessories	47,240	1,192	39,630
6	2869	Industrial organic chemicals, n.e.c.	38,075	512	74,366
7	3662	Radio & TV communication equipment	36,406	1,156	31,493
8	3312	Blast furnaces & steel mills	30,766	346	88,919
9	**3079**	**Miscellaneous plastics products**	**30,398**	**4,616**	**6,585**
10	3721	Aircraft	28,833	112	257,443
11	2711	Newspapers	25,980	2,375	10,938
12	2834	Pharmaceutical preparations	21,802	477	45,706
13	2621	Paper mills	20,348	341	59,673
14	**2821**	**Plastic materials & resins**	**19,739**	**456**	**43,289**
15	2026	Fluid milk	18,927	830	22,804
16	2086	Bottles & canned soft drinks	17,807	1,408	12,647
17	3861	Photographic equipment & supplies	17,486	360	48,574
18	2752	Commercial printing, lithographic	16,955	1,813	9,352
19	3679	Electronic components, n.e.c.	16,570	1,684	9,839
20	3661	Telephone & telegraph apparatus	16,535	230	71,893
21	3674	Semiconductors & related devices	16,214	382	42,477
22	2051	Bread, cake & related products	14,791	1,235	11,976
23	2111	Cigarettes	13,514	10	1,351,480
24	3671	Guided missiles & space vehicles	13,276	65	204,246
25	3531	Construction machinery	13,259	480	27,624
26	3585	Refrigeration & heating equipment	13,232	522	25,349
27	2421	Sawmills & planning mills, general	12,834	1,686	7,612
28	2819	Industrial inorganic chemicals, n.e.c.	12,777	580	22,030
29	2721	Periodicals	12,684	782	16,220
30	2013	Sausage & other prepared meats	12,064	713	16,921
31	3724	Aircraft engines & engine parts	11,795	171	68,978
32	2082	Malt beverages	11,700	69	169,575
33	2653	Corrugated & solid fiber boxes	11,168	1,062	10,516
34	2631	Paperboard mills	10,937	201	54,416
35	2099	Food preparations, n.e.c.	10,677	711	15,017
36	3731	Ship building & repairing	10,598	323	32,813
37	2841	Soap & other detergents	10,281	260	39,544
38	2844	Toilet preparations	10,189	272	37,459
39	3443	Fabricated plate work, boiler shops	10,172	1,120	9,082
40	2022	Cheese, natural & processed	10,151	321	31,623
41	3599	Machinery, exc. electrical, n.e.c.	10,097	2,813	3,589
42	2033	Canned fruits & vegetables	10,039	581	17,279
43	3441	Fabricated structural metal	9,677	1,557	6,215
44	2824	Organic fibers, noncellulosic	9,637	56	172,103
45	3533	Oil field machinery	9,637	391	24,647
46	3494	Valves & pipe fittings	9,552	704	13,568
47	2647	Sanitary paper products	9,532	94	101,408
48	3523	Farm machinery & equipment	9,514	737	12,909
49	3728	Aircraft equipment, n.e.c.	9,413	607	15,508
50	3519	Internal combustion engines, n.e.c.	9,322	148	62,988

n.e.c.: not elsewhere classified.

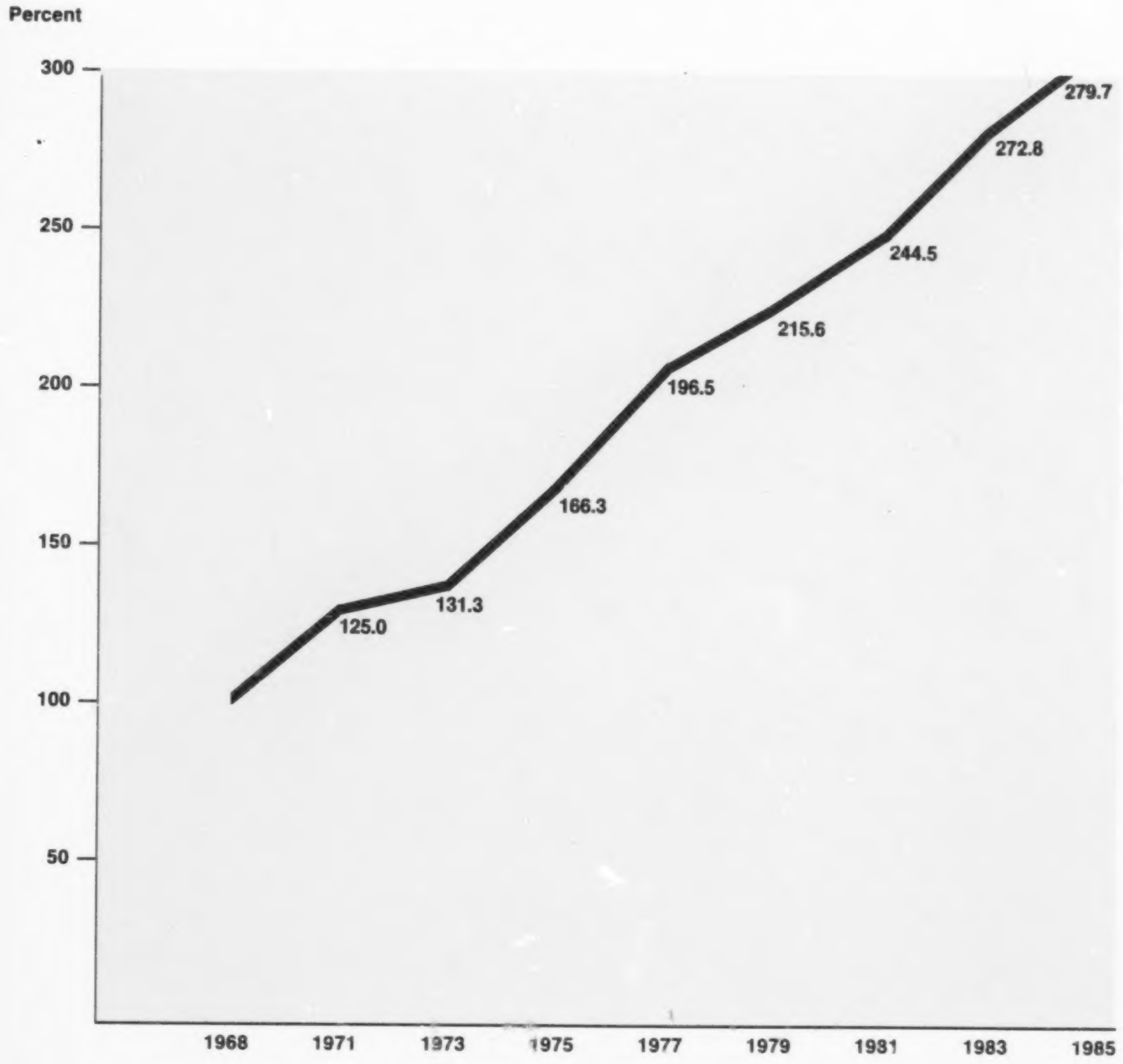
Definitions: Shipments: Output of all manufacturing plants. No. of Plants: Manufacturing establishments with 20 or more employees.

Sources: *Sales & Marketing Management's 1986 Survey of Industrial & Commercial Purchasing Power.*

TREND IN DISTRIBUTION OF SALES DOLLAR PLASTICS PROCESSING COMPANIES
1975-1985



PLASTICS PROCESSING COMPANIES
TREND IN STRAIGHT-TIME HOURLY WAGES
1968-1985 (1968 = 100)



SALES OF MAJOR U.S. PLASTICS PRODUCING COMPANIES

(rounded to nearest $25 million)

COMPANY[3]	PLASTICS SALES[1]		CHEMICALS SALES[2]		TOTAL SALES	
	1985	1984	1985	1984	1985	1984
1. Dow Chemical	3,700	3,750	6,300	6,575	11,525	11,425
2. Du Pont	3,475	3,875	7,350	8,100	29,475	30,550
3. Exxon	1,600	1,650	7,925	8,375	91,625	95,875
4. Mobil Oil	1,175	1,150	2,150	2,250	60,600	60,475
5. Union Carbide	1,050	1,100	2,925	3,200	9,000	9,500
6. Amoco	950	950	2,900	2,825	28,875	29,000
7. B.F. Goodrich	875	900	1,375	1,425	3,200	3,350
8. Monsanto	800	875	4,050	4,350	6,750	6,700
Shell Oil	800	700	3,200	3,300	20,475	20,900
10. W.R. Grace	775	775	2,875	2,900	7,250	6,850
11. Borg Warner	700	725	925	950	3,325	3,300
12. Hercules	675	725	2,050	1,875	2,575	2,575
Reichhold Chemicals	675	625	675	625	825	800
14. Phillips Petroleum	625	650	2,275	2,350	15,625	15,525
15. Chevron Oil	600	700	2,250	2,050	45,325	47,375
16. Celanese	550	675	1,525	1,625	3,050	3,325
17. Atlantic Richfield	525	525	2,150	2,100	22,500	24,575
18. National Distillers	475	500	1,025	1,075	2,300	2,250
19. General Electric	425	450	425	450	28,275	27,950
20. Rohm and Haas	400	425	1,975	1,950	2,050	2,050
21. Eastman Kodak	350	350	2,350	2,475	10,625	10,600
22. Allied-Signal	325	325	2,025	1,900	9,125	9,450
23. Goodyear Tire & Rubber	300	325	700	750	9,575	9,625
Certain Teed	300	350	300	350	1,100	1,200
25. Borden	275	250	1,525	1,450	4,725	4,575
26. Ethyl	250	300	1,250	1,350	1,550	1,675
27. U.S. Steel	225	250	1,225	1,375	19,275	19,100
28. Occidental Petroleum	200	200	1,625	1,650	15,650	16,225
Owens-Corning Fiberglas	200	225	200	225	3,300	3,025
30. Georgia-Pacific	175	175	175	250	6,725	6,675
31. Air Products & Chemicals	150	150	625	600	1,825	1,725

Note: There are several domestic and foreign-based companies which could be listed above had data been available such as Mobay, American Hoechst, Ciba-Geigy, Soltex Polymer, et al.

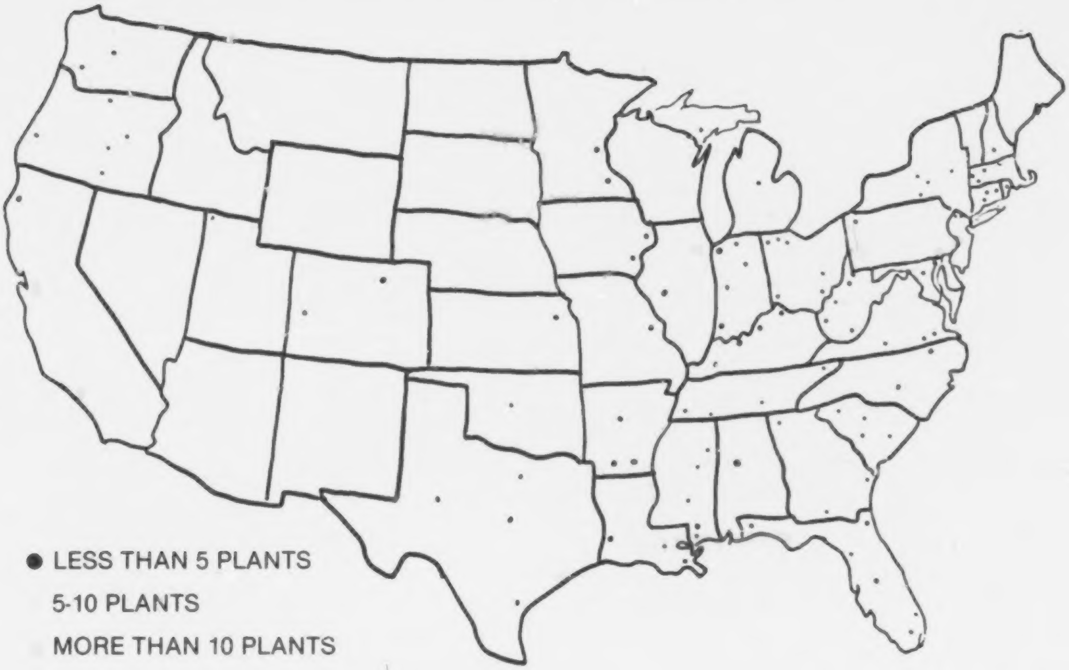
n.a.=not available

[1] Includes fabricated plastics products.

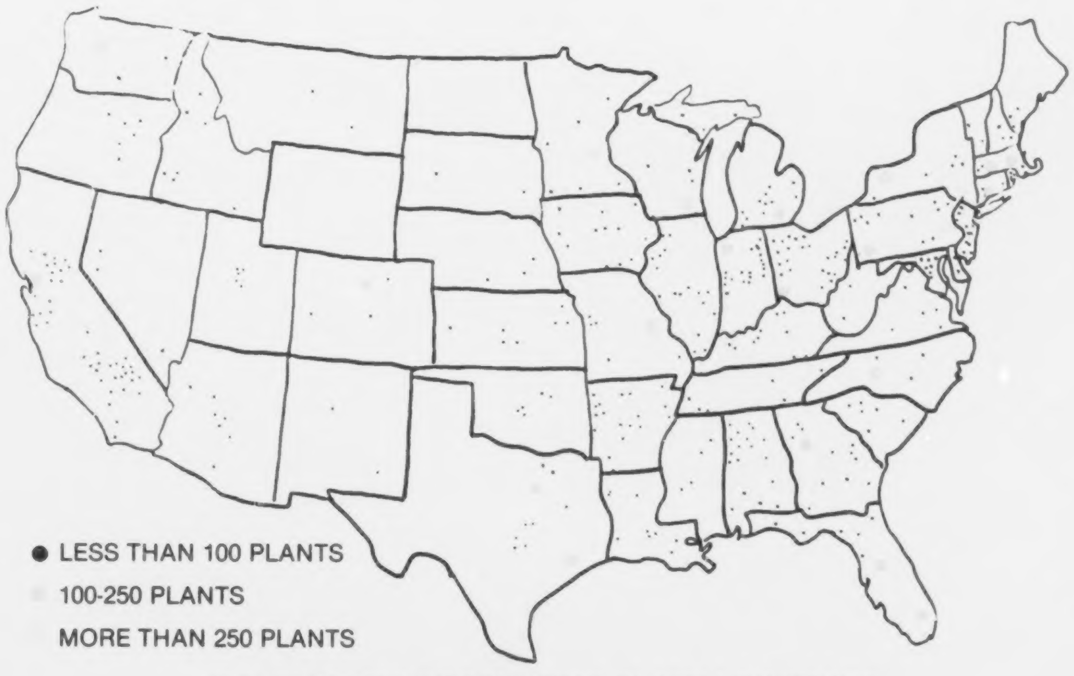
[2] Includes plastics.

[3] Ranked by plastics sales in 1985.

Source: Company annual reports, industry estimates.


● LESS THAN 5 PLANTS
5-10 PLANTS
MORE THAN 10 PLANTS

U.S. PLASTICS RESIN PLANT LOCATIONS


● LESS THAN 100 PLANTS
100-250 PLANTS
MORE THAN 250 PLANTS

U.S. PLASTICS PROCESSING PLANT LOCATIONS

TOP 10 STATES OF THE PLASTICS INDUSTRY—1982*

NUMBER OF ESTABLISHMENTS[1]

1. California	2,731
2. New York	1,444
3. Illinois	1,324
4. Ohio	1,233
5. New Jersey	1,209
6. Michigan	1,079
7. Texas	913
8. Pennsylvania	904
9. Massachusetts	837
10. Florida	662

NUMBER OF EMPLOYEES[2]

1. Ohio	86,300
2. California	79,000
3. Illinois	73,000
4. New Jersey	60,100
5. New York	52,100
6. Michigan	51,800
7. Pennsylvania	45,400
8. Massachusetts	40,600
9. Texas	35,700
10. Indiana	34,000

VALUE OF SHIPMENTS[3] ($MILLION)

1. Ohio	$7,902
2. California	6,680
3. Illinois	6,266
4. New Jersey	5,938
5. Texas	5,877
6. Michigan	4,131
7. Pennsylvania	4,079
8. New York	3,917
9. Massachusetts	3,434
10. Indiana	3,039

NEW CAPITAL EXPENDITURES ($ MILLION)

1. Texas	$523
2. Ohio	349
3. Illinois	274
4. California	260
5. Michigan	224
6. New Jersey	190
7. Pennsylvania	149
8. New York	136
9. So. Carolina	135
10. Massachusetts	131

PAYROLL ($ MILLION)

1. Ohio	$1,512
2. California	1,302
3. Illinois	1,233
4. New Jersey	1,043
5. Michigan	951
6. New York	840
7. Pennsylvania	789
8. Massachusetts	680
9. Texas	636
10. Indiana	582

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*The plastics industry includes establishments producing resins, machinery, fabricated products, and molds.

[1] A company operating at more than one location is required to file a separate report for each location (establishment)

[2] Includes all employees, administrative and manufacturing.

[3] Covers the received or receivable net selling values, f.o.b. plant (exclusive of freight and taxes), of all products shipped, both primary and secondary, as well as all miscellaneous receipts, such as receipts for contract work performed for others, installation and repair, sales of scrap, and sale of products bought and resold without further processing.

Source: Dept. of Commerce, Bureau of the Census
SPI estimates

PLASTICS PROCESSING INDUSTRY BY SALES GROUPS—1985

SALES LESS THAN $5 MILLION				SALES $5-$10 MILLION		
Less Profitable*	Median	More Profitable**	**Operating Statements**	Less Profitable*	Median	More Profitable**
100.0	100.0	100.0	Net Sales	100.0	100.0	
1.5	1.3	1.1	Less Adjustments & Allowances	1.1	0.9	0.5
98.5	98.7	98.9	Net Sales	98.9	99.1	99.5
38.6	37.7	36.0	Direct Materials	45.4	43.0	40.6
13.0	12.7	12.4	Direct Labor	11.3	10.1	9.5
8.1	7.7	7.4	Indirect Labor	6.4	7.3	8.7
3.7	3.2	2.7	Utilities	3.4	3.2	3.0
3.3	3.8	4.3	Depreciation	3.8	4.0	4.2
13.6	12.0	11.5	Other Mfg. Expense	9.3	10.5	12.1
(0.3)	0.1	0.5	Net on Tool Transactions	0.7	0.1	(0.6)
6.7	6.4	6.0	Selling Expenses	5.2	5.0	4.1
10.6	10.1	9.7	Administrative Expense	9.3	8.4	7.8
1.2	5.0	8.4	Operating Earnings	4.1	7.5	10.1
0.6	0.9	1.3	Other Income or (Expense)	2.1	1.6	(0.2)
0.6	4.1	7.1	Profit Before Income Taxes	2.0	5.9	10.3
0.2	1.8	2.7	Income Taxes	0.4	2.1	4.0
0.4	2.3	4.4	PROFIT AFTER INCOME TAXES	1.8	3.8	6.3
171.3%	186.9%	202.5%	Sales as Percentage of Total Assets	221.3%	196.3%	171.2%
			Balance Sheets			
4.5	4.8	4.8	Cash	2.6	3.7	4.9
25.9	26.3	26.8	Accounts & Notes Receivable	30.1	26.5	22.8
21.0	18.5	17.0	Inventory	23.5	20.7	17.9
1.9	1.9	1.6	Other Current Assets	1.5	1.6	1.8
53.3	51.5	50.2	CURRENT ASSETS	57.7	52.5	47.4
26.4	28.3	32.0	Land & Buildings, at Cost	25.0	25.6	26.2
10.1	9.7	8.8	Depreciation Reserve	6.6	6.5	6.5
64.1	62.4	57.7	Machinery & Equipment, at Cost	54.6	56.3	57.9
37.3	36.9	36.4	Depreciation Reserve	34.1	31.2	28.2
3.6	4.4	5.3	Other Long-Term Assets	3.4	3.3	3.2
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
3.9	6.7	9.5	Current Portion of Term Debt	3.5	3.6	3.7
24.0	23.3	22.6	Notes Payable	18.9	15.6	12.3
17.0	15.3	13.5	Accounts Payable, Trade	14.0	12.0	10.0
7.8	8.0	8.2	Other Payables & Accruals	6.1	7.7	9.2
52.7	53.3	53.8	CURRENT LIABILITIES	42.5	38.9	35.2
11.4	8.6	5.1	Other Long-Term Debt	2.7	3.4	4.0
64.1	61.9	58.9	TOTAL LIABILITIES	45.2	42.3	39.0
35.9	38.1	41.1	EQUITY (NET WORTH)	54.8	57.7	60.8
			Statistical Data			
(1.1%)	3.0%	8.7%	Percent Change in Sales, '85 vs '84	6.3%	7.6%	12.5
54.7	46.1	40.6	Cost of Sales/Inventory	48.0	48.7	48.6
55.2	51.4	48.3	Average Collection Period	49.6	49.3	48.6
1.0%	7.7%	14.4%	Profit Before Income Taxes/Assets	4.4%	11.6%	17.6%
1.9%	11.3%	21.7%	Net Income/Equity	7.2%	12.9%	17.7%

*PBIT less than 4.1 percent
**PBIT more than 4.1 percent

*PBIT less than 5.9 percent
**PBIT more than 5.9 percent

Source: SPI Financial and Operating Ratios Survey No. 24—1985

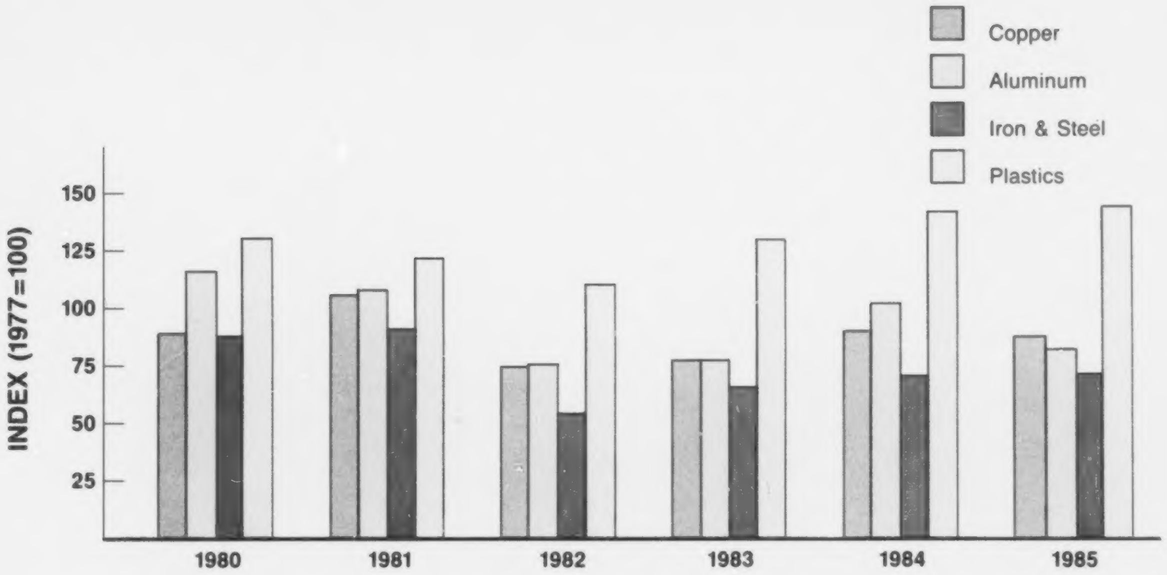
PLASTICS PROCESSING INDUSTRY BY SALES GROUPS—1985

SALES $10 MILLION OR MORE			Operating Statements
Less Profitable*	Median	More Profitable**	
100.0	100.0	100.0	Net Sales
2.1	1.7	1.2	Less Adjustments & Allowances
97.9	98.3	98.8	Net Sales
47.6	44.1	42.7	Direct Materials
11.9	11.3	10.5	Direct Labor
7.5	9.4	11.2	Indirect Labor
3.2	3.2	3.3	Utilities
3.8	3.1	2.3	Depreciation
6.9	7.1	7.4	Other Mfg. Expense
(0.1)	(0.3)	(0.6)	Net on Tool Transactions
6.3	4.9	3.6	Selling Expenses
7.9	8.1	8.3	Administrative Expense
2.9	7.4	10.1	Operating Earnings
2.0	1.5	1.2	Other Income or (Expense)
0.9	5.9	8.9	Profit Before Income Taxes
0.3	2.3	4.0	Income Taxes
0.6	3.6	4.9	PROFIT AFTER INCOME TAXES
173.0%	173.2%	173.3%	Sales as Percentage of Total Assets
			Balance Sheets
1.6	2.0	2.4	Cash
20.5	21.6	23.1	Accounts & Notes Receivable
17.7	16.9	15.6	Inventory
3.3	3.3	3.4	Other Current Assets
43.1	43.8	44.5	CURRENT ASSETS
24.8	23.3	21.8	Land & Buildings, at Cost
4.1	5.3	6.5	Depreciation Reserve
59.2	58.8	58.1	Machinery & Equipment, at Cost
33.0	28.7	24.6	Depreciation Reserve
10.0	8.1	6.7	Other Long-Term Assets
100.0	100.0	100.0	TOTAL ASSETS
2.7	1.8	0.9	Current Portion of Term Debt
7.5	8.1	8.6	Notes Payable
9.5	10.6	12.4	Accounts Payable, Trade
8.4	9.6	10.6	Other Payables & Accruals
28.1	30.1	32.5	CURRENT LIABILITIES
21.2	19.3	17.0	Other Long-Term Debt
49.3	49.4	49.5	TOTAL LIABILITIES
50.7	50.6	50.5	EQUITY (NET WORTH)
			Statistical Data
7.2%	6.7%	6.0%	Percent Change in Sales, '85 vs '84
45.0	44.6	41.0	Cost of Sales/Inventory
43.3	45.5	48.7	Average Collection Period
1.6%	10.2%	15.4%	Profit Before Income Taxes/Assets
2.0%	12.3%	16.8%	Net Income/Equity

*PBIT less than 5.9 percent
**PBIT more than 5.9 percent

Source: SPI Financial and Operating Ratios Survey No. 24—1985

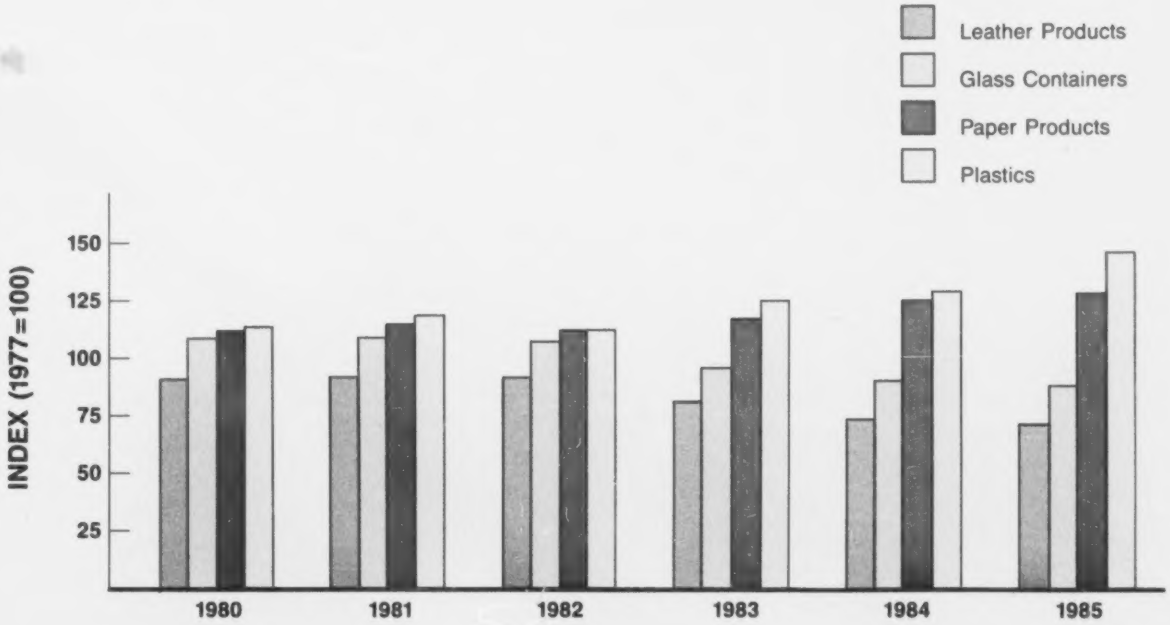
PLASTICS PRODUCTION vs COMPETITIVE MATERIALS



Source: SPI

Survey of Current Business

PLASTICS PRODUCTION vs COMPETITIVE PRODUCTS



Source: SPI

Survey of Current Business

FEEDSTOCKS
&
ADDITIVES

PLASTICS DERIVED FROM MAJOR FEEDSTOCKS*

(in millions of pounds)

	Total Production		Plastics Derivatives		Plastics % of Total	
FEEDSTOCK	**1985**	**1984**	**1985**	**1984**	**1985**	**1984**
Ethylene	30,550	31,175	21,940	20,805	72	67
Propylene	13,020	13,680	7,675	7,450	59	54
Benzene	9,875	9,800	7,495	7,305	76	75

* These data should not be construed to represent the entire feedstock needs of the U.S. plastics industry. They are based on 1984 and 1985 plastics production only and do not include feedstock needs for monomers, additives, and other chemicals not used in domestic production.

PLASTICS CONSUMPTION OF FEEDSTOCKS—1985

(millions of pounds)

Ethylene	Styrene Butadiene Latex	185	0.8
	Styrene Acrylonitrile	20	0.1
	Acrylonitrile Butadiene Styrene	185	0.8
	Polyvinyl acetate	270	1.2
	Polyethylene	16,340	74.5
	Polystyrene	1,360	6.2
	Other Styrenes	80	0.4
	Polyvinyl chloride	3,500	16.0
		21,940	100.0%
Propylene	Epoxy	150	2.0
	Phenolic	1,250	16.3
	Polypropylene	5,650	73.6
	Polyester	265	3.5
	Styrene Acrylonitrile	35	0.4
	Acrylonitrile Butadiene Styrene	325	4.2
		7,675	100.0%
Benzene	Acrylonitrile Butadiene Styrene	505	6.7
	Styrene Acrylontrile	55	0.7
	Styrene Butadiene Latex	435	5.8
	Polystyrene	3,700	49.4
	Other Styrenes	215	2.9
	Epoxy	260	3.5
	Polyester	275	3.7
	Nylon	565	7.5
	Phenolic	1,485	19.8
		7,495	100.0%

SELECTED PLASTICS PRECURSORS

	Total Production		Plastics Derivatives		Plastics % of Total	
PRECURSOR	**1985**	**1984**	**1985**	**1984**	**1985**	**1984**
Acrylonitrile	2,350	2,200	240	265	10	12
Bisphenol A	800	760	585	535	73	70
Butadiene	2,525	2,530	555	580	22	23
Cyclohexane	1,740	2,130	455	450	26	21
Formaldehyde	5,700	5,715	4,840	4,780	85	84
Maleic Anhydride	370	360	205	200	55	56
Phenol	2,775	2,845	2,265	2,150	82	76
Phthalic Anhydride	835	870	560	550	67	63
Styrene	7,450	7,700	5,890	5,865	79	76
Vinyl Acetate	2,110	2,025	2,110	2,025	100	100
Vinyl Chloride	7,775	7,515	7,775	7,515	100	100

Source: U.S. International Trade Commission, SRI International, Society of the Plastics Industry estimates

ADDITIVES FOR PLASTICS

ADDITIVE LUBRICANTS

These materials are added to plastics to assist flow in calendering, molding and extrusion by lubricating the metal surfaces in contact with the plastic. They also assist in knitting and wetting of the resin in mixing and milling operations. To be effective, lubricants must be compatible with the resins in which they are used, must not adversely affect the properties of end-products, and must be easily combined.

Examples: stearic acid, waxes, fatty acid esters, fatty acid amines.

ANTIOXIDANTS

They inhibit the oxidation of materials exposed to air or oxygen at normal or elevated temperatures. They are used in plastics which are subject to oxidative degradation, such as polyolefins, ABS, polystyrene, acetal and polyphenylene oxide.

Examples: alkylated phenols, amines, organic phosphites and phosphates, esters.

ANTISTATS

Chemicals which impart a slight to moderate degree of electrical conductivity to plastics compounds, thus preventing the accumulation of electrostatic charges on finished articles. They may be incorporated in the materials before molding, or applied to their surfaces after molding. They function either by being inherently conductive or by absorbing moisture from the air.

Examples: quaternary ammonium compounds, anionics, amines.

BLOWING AGENTS [FOAMING AGENTS]

Substances which alone or in combination with other substances are capable of producing a cellular structure in a plastic or rubber mass. Thus, the term includes compressed gases which expand when pressure is released, soluble solids that leave pores when leached out, liquids that develop cells when they change to gases, and chemical agents that decompose or react under the influence of heat to form a gas.

Examples: azodicarbonamide, modified azos, OBSH, HTBA.

COLORANTS

Dyes or pigments which impart color to plastics. The dyes are synthetic or natural compounds of submicroscopic or molecular size, soluble in most common solvents, yielding perfectly transparent colors. The pigments are organic and inorganic substances with larger particle sizes and usually insoluble in the common solvents. Colorants are added to plastics by dry coloring (tumbling the colorant with the base or compounded resin); by extrusion coloring (extruding a dry colored mixture and chopping it into pellets to be reprocessed); by masterbatching; or by stirring colorants or dispersions thereof into liquid plastisols or resin systems.

Examples: titanium dioxide, iron oxides, anthraquinones, carbon black.

FLAME RETARDANTS

Materials that reduce the tendency of plastic articles to burn. They are usually incorporated as additives during compounding, but sometimes are applied to surfaces of finished articles.

Examples: antimony trioxide, chlorinated paraffins, bromophenols.

HEAT STABILIZERS

Agents used in compounding some plastics to assist in maintaining the physical and chemical properties of the compounded materials at suitable values throughout the processing and service life of the material and/or the parts made therefrom. They protect plastics from the effects of heat such as changes in color, decrease in mechanical and electrical properties, and undesirable surface conditions.

Examples: lead, barium-cadmium, tin, calcium-zinc.

ORGANIC PEROXIDES

Thermally decomposable compounds which can initiate polymerization reactions and effect cross-linking upon decomposition. The rate of decomposition can be controlled by means of promoters or accelerators added to the system to increase the decomposition rate; or by inhibitors when it is desired to retard the decomposition.

Examples: MEK peroxide, benzoyl peroxide, alkyl peroxide, peresters.

PLASTICIZERS

Materials incorporated in a plastic or elastomer to increase its flexibility, workability or distensibility. Most plasticizers are nonvolatile organic liquids or low-melting point solids, which function by reducing the normal intermolecular forces in a resin thus permitting the macromolecules to slide over one another more freely.

Examples: adipates, azelates, trimellitates, DOP/DIOP/DIDP.

ULTRAVIOLET STABILIZERS (UV LIGHT ABSORBERS)

Chemical agents which absorb or screen out radiation beyond the violet end of the spectrum of visible radiations. Such radiation has sufficient energy to initiate reactions leading to the degradation of many plastics. These agents are often combined with other additives, e.g. heat stabilizers and antioxidants, with which they act in synergistic fashion.

Examples: benzophenones, benzotriazole, salicylates.

Source: Whittington's Dictionary of Plastics

CONSUMPTION OF ADDITIVES

(in millions of pounds)

TYPE	1981	1982	1983	1984	1985
Additive Lubricants	88	83	85	91	92
Antioxidants	34	31	34	35	37
Antistats	6	6	6	n.a.	n.a.
Blowing Agents	11	11	11	12	13
Colorants	331	320	367	392	398
Flame Retardants	420	378	418	453	460
Heat Stabilizers	86	78	81	85	83
Organic Peroxides	37	33	36	38	40
Plasticizers	1,505	1,327	1,445	1,635[r]	1,714
Ultraviolet Stabilizers	5	5	5	6	6

Source: Modern Plastics Magazine
r=revised from 1985 edition
n.a.=not available

DEFINITIONS OF PLASTICS

ACETAL

An engineering thermoplastic produced by the polymerization of purified formaldehyde [CH_2O] into both homopolymer and copolymer types. Typical applications are found in consumer products, automotive parts, and industrial machinery parts.

ACRYLICS

A family of thermoplastic resins of acrylic esters [$CH_2CHCOOR$] or methacrylic esters [$CH_2C(CH_3)COOR$]. The acrylates may be methyl, ethyl, butyl, or 2-ethylhexyl. Usual methacrylates are the methyl, ethyl, butyl, laural and stearyl. Typical applications are found in lighting fixtures, glazing and automotive parts.

ACRYLONITRILE BUTADIENE STYRENE

A class of thermoplastic terpolymers including a range of resins, all prepared with usually more than 50% styrene [$C_6H_5CHCH_2$] and varying amounts of acrylonitrile [CH_2CHCN] and butadiene [$CH_2CHCHCH_2$]. The three components are combined by a variety of methods involving polymerization, graft copolymerization, physical mixtures and combinations thereof. Typical applications are found in appliances, automotive parts, pipe, and business machine and telephone components.

ALKYDS

Thermosetting unsaturated polyester resins produced by reacting an organic alcohol with an organic acid, dissolved in and reacted with unsaturated monomers such as styrene [$C_6H_5CHCH_2$], diallyl phthalate [$C_6H_4(COOCH_2CHCH_2)_2$], diacetone acrylamide [$CH_3COCH_2C(CH_3)_2CHCHCONH_2$] or vinyl toluene [$CH_2CHC_6H_4CH_2$]. Typical applications are found in electrical uses, automotive parts, and as coatings.

CELLULOSICS

A family of thermoplastic resins manufactured by chemical modification of cellulose [$(C_6H_{10}O_5)_n$]. Included are: *cellophane*—regenerated cellulose made by mixing cellulose xanthate [ROCSSH] with a dilute sodium hydroxide [NaOH] solution to form a viscose, then extruding the viscose into an acid bath for regeneration; *cellulose acetate*—an acetic acid ester [$CH_3COOC_2H_5$] of cellulose; *cellulose acetate butyrate*—a mixed ester produced by treating fibrous cellulose with butyric acid [$CH_3CH_2CH_2COOH$], butyric anhydride [$(CH_3CH_2CH_2CO)_2O$], acetic acid [CH_3COOH] and acetic anhydride [$(CH_3CO)_2O$] in the presence of sulfuric acid [H_2SO_4]; *cellulose propionate*—formed by treating fibrous cellulose with propionic acid [$CH_3CH_2CO_2H$] and acetic acid and anhydrides in the presence of sulfuric acid; *cellulose nitrate*—made by treating fibrous cellulosic materials with a mixture of nitric [HNO_3] and sulfuric acids. Typical applications of cellulosics are found in packaging, consumer products, and automotive parts.

COUMARONE-INDENE

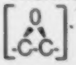
Thermoplastic resin obtained by heating mixtures of coumarone [C_8H_6O] and indene [$C_6H_4CH_2CHCH$] with sulfuric acid (H_2SO_4] to promote polymerization. These resins have no commercial applications when used alone. They are used primarily as processing aids, extenders and plasticizers with other resins in asphalt floor tile.

DIALLYL PHTHALATE(DAP)

The term DAP is used both for the monomeric and polymeric forms. The monomer [$C_6H_4(COOCH_2CHCH_2)_2$] is used as a cross-linking agent in unsaturated polyester resins. As a polymer, it is used in the production of thermosetting molding powders, casting resins and laminates.

EPOXY

Thermosetting resins, that, in the uncured form, contain one or more reactive epoxide or oxirane groups



. These epoxide groups serve as cross-linking points in the subsequent curing step, in which the uncured epoxy is reacted with a curing agent or hardener. Cross-linking is accomplished through the epoxide groups as well as through hydroxyl groups that may be present. Most conventional unmodified epoxy resins are produced from epichlorohydrin (chloropropylene oxide) [CH_2OCHCH_2Cl] and bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$]. The other types of epoxy resins are phenoxy resins, novolac resins, and cycloaliphatic resins. Epoxy resins are used as protective coatings, bonding adhesives, in building and construction, and electrical uses, plus many other uses.

FLUOROPOLYMERS

A family of thermoplastic resins analogous to polyethylene in which some of the hydrogen atoms attached to the carbon chain are replaced by fluorine or fluorinated alkyl groups. In some cases, other halogens such as chlorine are also part of the molecule. The most common commercial fluoropolymers are: *FEP* (fluorinated ethylene-propylene) from tetrafluoroethylene [C_2F_4] and hexafluoropropylene [C_3F_6]; *PTFE* (polytetrafluoroethylene) from the polymerization of tetrafluoroethylene and ethylene [C_2H_4]; *PFA* (perfluoroalkoxy) from tetrafluoroethylene and perfluoropropyl vinyl ether [$C_3H_7C_4OF_5$]; *PCTFE* (polychlorotrifluoro-ethylene) from chlorotrifluoro-ethylene monomer [C_2F_3Cl]; *CTFE-VDF* (polychlorotrifluoroethylenevinylidene fluoride) from chlorotrifluoroethylene and vinylidene fluoride [$C_2H_2F_2$]; *E-CTFE* (polyethylene-chlorotrifluoroethylene) from chlorotrifluoroethylene and ethylene; *PVDF* (polyvinylidene fluoride) from vinylidene fluoride monomer; and, *PVF* (polyvinyl fluoride) from vinyl fluoride monomer [C_2H_3F]. Typical applications for fluoropolymers are found in electrical/electronic uses and pipe and chemical processing equipment.

MELAMINE-FORMALDEHYDE

Thermosetting resins formed by the condensation reaction of formaldehyde [$HCHO$] and melamine [$C_3N_3(NH_2)_3$]. The chemistry is analogous to that of urea-formaldehyde except that the three amino groups of melamine provide more possibilities for cross-linking, are more highly reactive, and all six hydrogen atoms of melamine will react, forming the hexamethyl compound. Typical applications are found in bonding and adhesives, coatings, and consumer products.

NITRILE RESINS

Thermoplastic resins composed of acrylonitrile [CH_2CHCN], along with co-monomers such as acrylates, methacrylates, butadiene [$CH_2CHCHCH_2$] and styrene [$C_6H_5CHCH_2$]. Both straight copolymers and copolymers grafted onto elastomeric backbones are available. The unique property of these materials is outstanding resistance to passage of gases and water vapor, making them useful in packaging applications.

NYLON

A generic name for a family of long-chain polyamide engineering thermoplastics which have recurring amide groups [-CO-NH-] as an integral part of the main polymer chain. Nylons are synthesized from intermediates such as dicarboxylic acids, diamines, amino acids and lactams, and are identified by numbers denoting the number of carbon atoms in the polymer chain derived from specific constituents, those from the diamine being given first. The second number, if used, denotes the number of carbon atoms derived from a diacid. Commercial nylons are as follows: *nylon 4* (polypyrrolidone)—a polymer of 2-pyrrolidone [$CH_2CH_2CH_2C(O)NH$]; *nylon 6* (polycaprolactam)—made by the polycondensation of caprolactam [$CH_2(CH_2)_4NHCO$]; *nylon 6/6*—made by condensing hexamethylenediamine [$H_2N(CH_2)_6NH_2$] with adipic acid [$COOH(CH_2)_4COOH$]; *nylon 6/10*—made by condensing hexamethylenediamine with sebacic acid [$COOH(CH_2)_8COOH$]; *nylon 6/12*—made from hexamethylenediamine and a 12-carbon dibasic acid; *nylon 11*—produced by polycondensation of the monomer 11-amino-undecanoic acid [$NH_2CH_2(CH_2)_9COOH$]; *nylon 12*—made by the polymerization of laurolactam [$CH_2(CH_2)_{10}CO$] or cyclododecalactam, with 11 methylene units between the linking -NH-CO- groups in the polymer chain. Typical applications for nylons are found in automotive parts, electrical/electronic uses, and packaging.

PETROLEUM RESINS

Thermoplastic resins obtained from a variable mixture of unsaturated monomers recovered as a byproduct from cracked and distilled petroleum streams. They also contain indene [$C_6H_4CH_2CHCH$], which is copolymerized with a variety of other monomers including styrene [$C_6H_5CHCH_2$], vinyl toluene [$CH_2CHC_6H_4CH_3$], and methyl indene [$C_6H_3CH_3CH_2CHCH$]. Typical applications are found in adhesives, printing inks, rubber compounding, and surface coatings.

PHENOLIC

These thermosetting resins are credited with being the first commercialized wholly synthetic polymer or plastic. The basic raw materials are formaldehyde [$HCHO$] and phenol [C_6H_5OH], although almost any reactive phenol or aldehyde can be used. The phenols used commercially are phenol, cresols [$CH_3C_6H_4OH$], xylenols [$(CH_3)_2C_6H_3OH$], p-t-butylphenol [$C_4H_9C_6H_4OH$], p-phenylphenol [$C_6H_5C_6H_4OH$], bisphenols [$(C_6H_4OH)_2$], and resorcinol [$C_6H_4(OH)_2$]. The aldehydes used are formaldehyde and furfural [C_4H_3OCHO]. In the uncured and semi-cured condition, phenolic resins are used as adhesives, casting resins, potting compounds, and laminating resins. As molding powders, phenolic resins can be found in electrical uses.

POLYAMIDE-IMIDE

Engineering thermoplastic resins produced by the condensation reaction of trimellitic anhydride [$OCC_6H_2C_2O_3$] and various aromatic diamines. Typical applications are found in aerospace, automotive and heavy equipment industries.

POLYARYLATES

Engineering thermoplastic resins produced by interfacial polymerization of an aqueous solution of the disodium salt of bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$] with phthalic acid chlorides [$C_6H_4(CO)_2Cl_2$] in methylene chloride (CH_2Cl_2]. The major use of polyarylates is in outdoor lighting.

POLYBUTYLENE

Thermoplastic resins produced via stereospecific Ziegler-Natta polymerization of butene-1 monomer [$CH_2CHCH_2CH_3$]. Typical applications are found in pipe and packaging film.

POLYCARBONATE

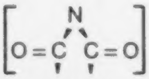
Engineering thermoplastic resins produced by (1) phosgenation of dihydric phenols, usually bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$], (2) ester exchange between diaryl carbonates and dihydric phenols, usually between diphenyl carbonate [$(C_6H_5O)_2CO$] and bisphenol A and (3) interfacial polycondensation of bisphenol A and phosgene [$COCl_2$]. Typical applications are found in glazing, appliances, and electrical uses.

POLYETHYLENE

A family of thermoplastic resins obtained by polymerizing the gas ethylene [C_2H_4]. Low molecular weight polymers of ethylene are fluids used as lubricants; medium weight polymers are waxes miscible with paraffin; and the high molecular weight polymers (i.e. over 6000) are the materials used in the plastics industry. Polymers with densities ranging from about .910 to .925 are called *low density;* those of densities from .926 to .940 are called *medium density;* and those from .941 to .965 and over are called *high density.* The low density types are polymerized at very high pressures and temperatures, and the high density types at relatively low temperatures and pressures. A relatively new type called linear low density polyethylene is manufactured through a variety of processes: gas phase, solution, slurry, or high pressure conversion. A high efficiency catalyst system aids in the polymerization of ethylene at lower temperatures and pressures than required in conventional low density polyethylene. Copolymers of ethylene with vinyl acetate ethyl acrylate, and acrylic acid are commercially important. Major polyethylene applications can be found in packaging, housewares, toys, and communications equipment.

POLYIMIDES

A family of thermoset and thermoplastic resins characterized by repeating imide linkages



There are four types of aromatic polyimides: (1) condensation products made by the reaction of pyromellitic dianhydride (PMDA) [$C_6H_2(C_2O_3)_2$] and aromatic diamines such as 4,4'-diaminodiphenyl ether [$(C_6H_4NH_2)_2O$]; (2) condensation products of 3,4,3',4'-benzophenone tetracarboxylic dianhydride (BTDA) [$(C_6H_5)_2CO(C_2O_3)_2$] and aromatic amines; (3) the reaction of BTDA and a diisocyanate such as 4,4'-methylene-bis(phenylisocyanate) [$OCNC_6H_4CH_2C_6H_4NCO$]; and, (4) a polyimide based on diaminophenylindane and a dicarboxylic anhydride such as carbonyldiphthalic anhydride [$OC_6H_4(CO)_2COC_6H_4(CO)_2O$]. Thermoset polyimides are produced in condensation polymers that possess reactive terminal groups capable of subsequent cross-linking through an addition reaction. Typical applications for thermoplastic and thermosetting polyimides are in transportation and electronics.

POLYPHENYLENE OXIDE, MODIFIED

Engineering thermoplastic resins produced by the oxidative coupling of 2, 6-dimethylphenol [$(CH_3)_2C_6H_3OH$] (xylenol), then blended with impact polystyrene. Typical applications are found in electrical/electronic uses, business machine parts, appliances, and automotive parts.

POLYPHENYLENE SULFIDE

Engineering thermoplastic resins produced by the reaction of p-dichlorobenzene [$C_6H_4Cl_2$] with sodium sulfide [Na_2S]. The major use for polyphenylene sulfide is in electrical/electronic parts and automotive parts.

POLYPROPYLENE

Thermoplastic resins made by polymerizing propylene [CH_3CHCH_2] and in the case of copolymers with monomers, with suitable catalysts, generally aluminum alkyl and titanium tetrachloride mixed with solvents. The monomer unit in polypropylene is asymmetric and can assume two regular geometric arrangements: isotactic, with all methyl groups aligned on the same side of the chain, or syndiotactic, with the methyl groups alternating. All other forms, where this positioning is random, are called atactic. Commercial polypropylene contains 90-97% crystalline or isotactic PP with the remainder being atactic. Most processes remove excess atactic PP. This by-product is used in adhesives, caulks, and cable-filling compounds. Major applications of commercial PP are found in packaging, automotive, appliance and carpeting markets.

POLYSTYRENE

High molecular weight thermoplastic resins produced generally by the free-radical polymerization of styrene monomer [$C_6H_5CHCH_2$] which can be initiated by heating alone but more effectively by heating in the presence of a free-radical initiator (such as benzoyl peroxide [$(C_6H_5CO)_2O_2$]). Typical processing techniques are modified mass polymerization or solution polymerization, suspension polymerization, and expandable beads. Major markets for polystyrene are in consumer and institutional products, electrical/electronic uses, and building/construction.

POLYURETHANES

A large family of polymers based on the reaction product of an organic isocyanate with compounds containing a hydroxyl group. The commonly used isocyanates are toluene diisocyanate (TDI) [$CH_3C_6H_3(NCO)_2$], methylene diphenyl isocyanate (MDI) [$OCNC_6H_4CH_2C_6H_4NCO$], and polymeric isocyanates (PMDI), obtained by the phosgenation of polyamines derived from the condensation of aniline [$C_6H_5NH_2$] with formaldehyde [$HCHO$]. Polyols (with hydroxyl groups) are macroglycols which are either polyester or polyether based. Polyurethane elastomers and resins take the form of liquid casting systems, thermoplastic elastomers and resins, microcellular products, and millible gums. Typical applications are found in the automotive industry. Polyurethane foams are widely used in transportation, furniture, and construction markets.

POLYVINYL ACETATE (PVAc) & OTHER VINYLS

Polyvinyl acetate is a thermoplastic resin produced by the polymerization of vinyl acetate monomer [$CH_3COOCHCH_2$] in water producing an emulsion with a solids content of 50-55%. Most polyvinyl acetate emulsions contain co-monomers such as n-butyl acrylate, 2-ethyl hexyl acrylate, ethylene, dibutyl maleate and dibutyl fumarate. Polymerization of vinyl acetate with ethylene also can be used to produce solid vinyl acetate/ethylene copolymers with more than 50% vinyl acetate content. Polyvinyl alcohol (PVOH) is produced by methanolysis or hydrolysis of polyvinyl acetates. The reaction can be controlled to produce any degree of replacement of acetate groups. Co-polymers of replaced acetate groupings and other monomers such as ethylene and acrylate esters are commercially important. *Polyvinyl butyral* (PVB)—made by reacting PVOH with butyraldehyde [$CH_3(CH_2)_2CHO$]. *Polyvinyl formal*—made by condensing formaldehyde [$HCHO$] in the presence of PVOH or by the simultaneous hydrolysis and acetylization of PVAc. *Polyvinylidene chloride*—made by the polymerization of 1,1-dichloroethylene [CH_2CCl_2]. Typical applications for the above resins are found in adhesives, paints, coatings and finishes, and packaging.

POLYVINYL CHLORIDE

Thermoplastic resins produced by the polymerization of the gas vinyl chloride [CH_2CHCl]. Under pressure, vinyl chloride becomes liquified and is polymerized by one of four basic processes: suspension, emulsion, bulk, and solution polymerization. The pure polymer is hard, brittle and difficult to process, but it becomes flexible when plasticizers are added. A special class of PVC resin of fine particle size, often called dispersion grade resin, can be dispersed in liquid plasticizers to form plastisols. The addition of a volatile diluent or a solvent to the plastisol produces an organosol. Copolymers with vinyl acetate, vinylidene chloride, and maleate and fumarate esters find commercial application. Major markets for PVC are in building/construction, packaging, consumer and institutional products, and electrical/electronic uses.

STYRENE ACRYLONITRILE

Thermoplastic copolymers of styrene [$C_6H_5CHCH_2$] and acrylonitrile [CH_2CHCN]. SAN resins are random, amorphous copolymers produced by emulsion, suspension, or continuous mass polymerization. Typical uses include automobile instrument lenses and housewares.

STYRENE BUTADIENE LATEXES & OTHER STYRENE COPOLYMERS

Styrene butadiene latexes usually have a resin content of about 50%. The styrene/butadiene ratio varies from 54:46 to 80:20. Most are carboxylated by the use of such acids as maleic [HOOCCHCHCOOH], fumaric [HOOCCHCHCOOH], acrylic [$CH_2CHCOOH$], or methacrylic [$CH_2C(CH_3)COOH$]. Two types of *styrene-maleic anhydride* (SMA) [$(COCH)_2O$] are available: SMA copolymers, with and without rubber impact modifier (e.g. DYLARK®) and SMA terpolymer alloys (e.g. CADON®). *K-Resin®* is a solid styrene-butadiene copolymer resin. Acrylic monomers are also used in conjunction with styrene (or styrene plus other monomers) to produce specialty resins. For example, there are transparent terpolymers of methyl methacrylate, butadiene, and styrene (MBS), and others of acrylonitrile, an acrylic monomer, and styrene (AAS). Ion-exchange resins or divinylbenzene-modified polystyrene are another variation. SB latexes are used in carpet backing and paper coatings. The other styrenics are used in paints, coatings, and floor polishes, plus many other uses.

SULFONE POLYMERS

A family of engineering thermoplastic resins characterized by the sulfone [SO_2] group. *Polysulfone* is made by the reaction of the disodium salt of bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$] with 4,4'-dichlorodiphenyl sulfone(4,4'-DCDPS [$(C_6H_4Cl)_2SO_2$]. *Polyethersulfone* is made by the reaction of 4,4'-DCDPS with potassium hydroxide [KOH]. *Polyphenylsulfone* is similar to the other sulfone polymers. Typical applications for sulfone polymers are found in electrical/electronic uses and automotive parts.

THERMOPLASTIC POLYESTER (SATURATED)

A family of polyesters in which the polyester backbones are saturated and hence unreactive. The most common commercial types are: *PET* (polyethylene terephthalate) produced by polycondensation of ethylene glycol [CH_2OHCH_2OH] with either dimethyl terephthalate (DMT) [$C_6H_4(COOCH_3)_2$] or terephthalic acid (TPA) [$C_6H_4(COOH)_2$]; and *PBT* (polybutylene terephthalate) produced by the reaction of DMT with 1,4 butanediol [$NO(CH_2)_4OH$]. Typical applications are found in packaging, automotive, electrical, and consumer markets.

UREA-FORMALDEHYDE

Formed by the condensation reaction of formaldehyde [HCHO] and urea [$CO(NH_2)_2$]. These thermoset resins are clear water-white syrups or white powdered materials which can be dispersed in water to form colorless syrups. They cure at elevated temperatures with appropriate catalysts. Molding powders are made by adding fillers to the uncured syrups, forming a consistency suitable for compression and transfer molding. The liquid and dried resins find extensive use in laminates and chemically-resistant coatings. The molding compounds are formed into rigid electrical and decorative products.

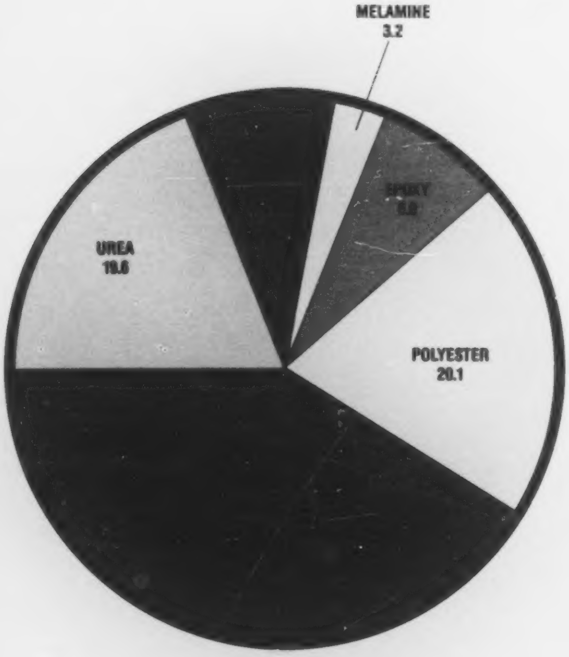
UNSATURATED POLYESTER

Thermosetting resins made by the condensation reaction between difunctional acids and glycols. The resulting polymer is then dissolved in styrene [$C_6H_5CHCH_2$] or other vinyl unsaturated monomer. The structures of the acids and glycols used and their proportions, especially the ratio of the unsaturated versus the saturated acid, and the type and amount of monomer used, are all tailored for each resin to balance economy, processing characteristics, and performance properties. One common formulation is the reaction of maleic anhydride [$(COCH)_2O$], phthalic anhydride [$C_6H_4(CO)_2O$], and propylene glycol [$CH_3CHOHCH_2OH$]. Both dicyclopentadiene [$(C_5H_5)_2$] and isophthalic acid [$C_6H_4(COOH)_2$] can be substituted for phthalic anhydride. Vinyl ester resins are linear reaction products of bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$] and epichlorohydrin [CH_2OCHCH_2Cl] that are terminated with an unsaturated acid such as methacrylic acid [$CH_2C(CH_3)COOH$]. Typical applications are found in transportation, appliances, electrical, and construction markets.

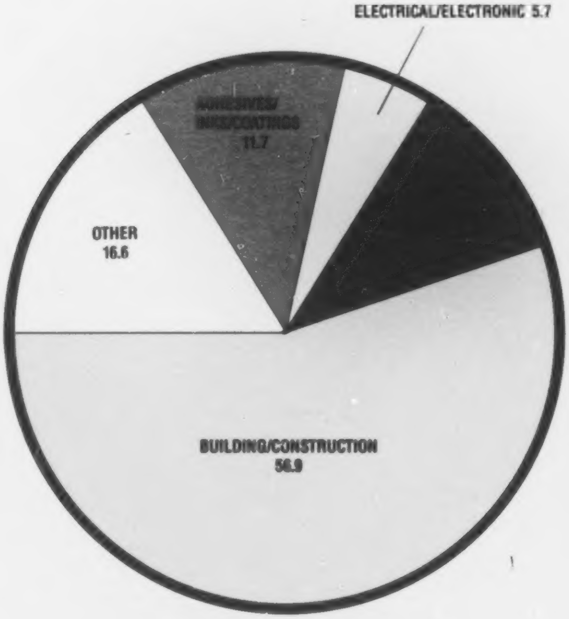
Sources: *Chemical Economics Handbook*, SRI International
Modern Plastics Encyclopedia
Whittington's Dictionary
The Condensed Chemical Dictionary

THERMOSETTING RESINS

Plastics which in their final state as finished articles are substantially infusible and insoluble. They are often liquids at some state of their manufacture or processing, which are cured by heat, catalysts or other chemical means. After being fully cured, thermosets cannot be resoftened by heat.



1985 PERCENT OF THERMOSET RESIN
SALES & CAPTIVE USE
BY MATERIAL



1985 PERCENT OF THERMOSET RESIN
SALES & CAPTIVE USE
BY MAJOR MARKET

EPOXY

MANUFACTURERS*

Celanese Engineering Resins Co.
Ciba-Geigy Corp.
Dow Chemical U.S.A.
Reichhold Chemicals, Inc.
Shell Chemical Co.
Union Carbide Corp.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1985.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	244	250
1977	261	278
1978	299	316
1979	361	332
1980	315	319
1981	336	332
1982	286	301
1983	334	331
1984	406	379
1985	385	367
COMPOUND GROWTH RATE		
1975–1985	6.9%	7.0%

	PERCENT OF TOTAL U.S. SALES & CAPTIVE USE
1976	0.88
1977	0.85
1978	0.86
1979	0.82
1980	0.86
1981	0.86
1982	0.82
1983	0.78
1984	0.84
1985	0.77

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

EPOXY

DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

END-USE	1981	1982	1983	1984	1985
Bonding & adhesives	18	15	15	20	17
Flooring, paving and aggregates	20	18	19	18	17
Protective coatings	137	122	131	153	168
Fiber reinforced laminates & composites	66	58	74	87	69
Tooling, casting, and molding resins	29	24	28	31	23
All other cases	21	25	29	29	31
Total	291	262	296	338	325

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	*	*	*	*	*
Packaging	*	*	*	*	*
Building/Construction	49	44	36	36	39
Electrical/Electronic	58	60	73	82	72
Furniture/Furnishings	—	—	*	*	*
Consumer & Institutional	*	*	—	*	*
Industrial/Machinery	*	*	*	*	*
Adhesives, Inks & Coatings	151	134	118	122	140
All Other	33	24	69	98	74
Exports	41	39	35	41	42
Total	332	301	331	379	367

* Included in All Other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

EPOXY
TYPICAL APPLICATIONS

- Coatings
- Electrical laminates
- Floor/paving aggregates
- Reinforced composites
- Electrical/Electronic casting
- Adhesives and molding

PC board designers use an epoxy-based resin system for high temperature pc board applications. The QUATREX 5010 Electronic Grade Resin system achieves a glass transition temperature (Tg) exceeding 180°C for pc board laminates. QUATREX 5010 is supplied by the Dow Chemical Company.

PHENOLIC

MANUFACTURERS*

- Acme Resins Co.
- Allied Bendix
- American Hoechst Corp.
- Ametek, Haveg Div.
- Ashland Chemical Co.
- Borden Chemical Co., Inc.
- Chembond Corp.
- Formica Corp.
- Georgia-Pacific Corp.
- Inmont Corp.
- Ironsides Resins, Inc.
- Koppers Co.
- Masonite Corp.
- Occidental Chemical Corp.
- Owens-Corning Fiberglas Corp.
- Perkins Industries, Inc.
- Pioneer Plastics Corp.
- Plaslok Corp.
- Plastics Engineering Co.
- Polymer Applications, Inc.
- Polyrez Co., Inc.
- Raymark Industries, Inc.
- Reichhold Chemicals, Inc.
- Rogers Corp.
- Union Carbide Corp.
- Valite Div., Valentine Sugars, Inc.
- Van Leer Containers, Inc.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1985.

PRODUCTION AND SALES & CAPTIVE USE**

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	1,340	1,305
1977	1,458	1,400
1978	1,827	1,788
1979	1,781	1,732
1980	1,499	1,517
1981	2,333	2,375
1982	2,006	2,060
1983	2,484	2,529
1984	2,502	2,510
1985	2,621	2,640

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE*

1976	4.60
1977	4.27
1978	4.86
1979	4.27
1980	4.11
1981	6.12
1982	5.62
1983	5.99
1984	5.55
1985	5.56

*Gross weight basis of reporting begun in 1981, so data are not comparable before then.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

PHENOLIC
DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

End-use	1981	1982	1983	1984	1985
Molding Compounds	249	192	232	238	209
Bonding & adhesive resins for:					
Laminating	134	127	166	149	142
Coated & bonded abrasives	37	25	28	23	16
Friction materials	29	25	32	35	26
Insulation materials	362	347	355	307	419
Foundry & shell molding	82	56	70	81	77
Plywood	1,110	1,012	1,309	1,319	1,255
Fibrous & granulated wood	201	146	179	184	217
Resins sold to Rubber Industry	24	23	27	30	28
All other	59	51	59	62	159
Protective coatings	26	18	19	22	23
All other uses	42	23	30	38	48
Total	2,355	2,045	2,506	2,488	2,619

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	167	129	156	150	124
Packaging	*	*	*	*	*
Building/Construction	1,672	1,543	1,936	1,921	1,950
Electrical/Electronic	209	170	176	162	128
Furniture/Furnishings	25	26	*	*	*
Consumer & Institutional	*	*	44	*	*
Industrial/Machinery	27	*	11	9	7
Adhesives, Inks & Coatings	166	73	70	80	82
All Other	89	104	113	166	328
Exports	20	15	23	22	21
Total	2,375	2,060	2,529	2,510	2,640

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

PHENOLIC

TYPICAL APPLICATIONS

- Wiring devices
- Connectors
- Transmission parts
- Pulleys
- Electrical switch gear
- Closures
- Handles
- Telephone relay systems
- Rubber tackifiers
- Laminating plywood
- Knobs
- Power brake components

Koppers Company, Inc., has introduced the Gold Seal 10-Year Guarantee for certain roof systems used in conjunction with the company's Exeltherm Xtra® phenolic foam insulation board, which offers exceptional fire resistance and smoke development properties.

UNSATURATED POLYESTER

MANUFACTURERS*

- Advance Coatings Corp.
- Alpha Chemical Corp.
- Ashland Chemical Co.
- AZS Corp.
- Cargill, Inc.
- Cook Paint & Varnish Co.
- Dow Chemical U.S.A.
- Freeman Chemical Corp.
- Glidden Coatings & Resin Div. SCM Corp.
- ICI Americas, Inc.
- Inmont Corp.
- Interplastics Corp.
- Koppers Co.
- Owens-Corning Fiberglas Corp.
- Pioneer Plastics Corp.
- Reichhold Chemicals, Inc.
- Sohio Chemical Co.
- USS Chemicals Co.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1985.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	1,042	959
1977	1,061	1,045
1978	1,209	1,199
1979	1,147	1,152
1980	947	949
1981	997	977
1982	865	851
1983	1,084	1,072
1984	1,232	1,231
1985	1,223	1,233
COMPOUND GROWTH RATE		
1975–1985	3.9%	4.8%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1976	3.38
1977	3.19
1978	3.26
1979	2.84
1980	2.57
1981	2.52
1982	2.32
1983	2.54
1984	2.72
1985	2.60

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

UNSATURATED POLYESTER
MAJOR DOMESTIC MARKETS
(in millions of pounds)

	1981	1982	1983	1984	1985
DOMESTIC REINFORCED PLASTICS, TOTAL	**764**	**629**	**818**	**939**	**949**
Marine and marine accessories	169	156	215	249	246
Transportation	84	65	88	99	120
Auto, trucks, buses, etc.	65	53	75	83	100
Other transportation	19	12	13	16	20
Construction	301	279	340	389	382
General construction	122	114	135	172	158
Bathroom components & fixtures, general purpose tanks & pipes	78	75	93	100	112
Corrosion resistant tanks, pipes, etc.	101	90	112	117	112
Electrical generation, transmission and distribution	22	17	26	37	27
Consumer goods	66	51	81	85	96
Major appliances and parts	10	19	21	19	21
Recreational goods, toys, etc.	24	22	40	39	42
Other consumer goods	32	10	20	27	33
Gel coats	32	31	36	43	38
Other reinforced	90	30	32	37	40
DOMESTIC NON-REINFORCED PLASTICS, TOTAL	**202**	**214**	**244**	**283**	**276**
Castings	123	103	118	161	160
Furniture	7	4	4	5	7
Cultured marble & onyx	61	62	81	107	107
Other	55	37	33	49	46
Autobody putty	45	60	61	56	61
Surface and protective coatings	5	4	5	5	6
Bonding and adhesives	3	2	2	3	2
Minebolt anchor resins	n.a.	n.a.	n.a.	21	20
Other non-reinforced	26	45	58	37	27

n.a. = not available
Source: Quarterly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

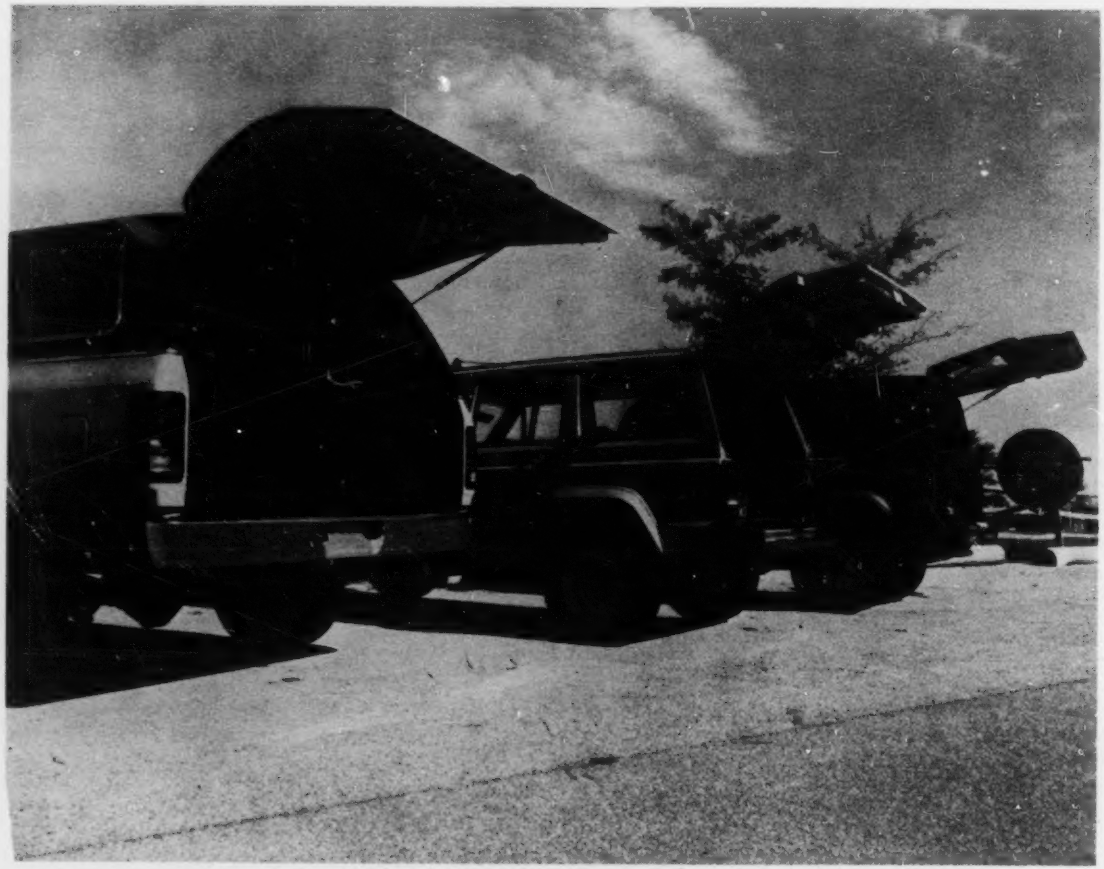
DISTRIBUTION BY MAJOR MARKET
(in million of pounds)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	259	244	316	388	411
Packaging	*	—	—	—	—
Building/Construction	401	353	496	502	487
Electrical/Electronic	33	26	52	66	61
Furniture/Furnishings	24	3	2	11	11
Consumer & Institutional	94	95	81	72	60
Industrial/Machinery	*	—	*	*	*
Adhesives, Inks & Coatings	9	7	*	*	*
All Other	146	115	115	184	194
Exports	11	8	10	8	9
Total	**977**	**851**	**1,072**	**1,231**	**1,233**

*Included in all other.
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

UNSATURATED POLYESTER
TYPICAL APPLICATIONS

Panels
Tanks
Auto components
Sanitary fixtures
Synthetic marble
Recreational vehicles
Pleasure boats
Bowling balls
Showerstalls



Three leading utility vehicles use SMC (glass reinforced polyester Sheet Molding Compound) liftgates on their 1984 models. The two-piece assemblies reduce the number of parts and assembly operations requirred for a steel liftgate, and provide built-in corrosion resistance and easy handling due to a reduction in weight. Shown are Dodge Ramcharger (foreground), AMC Jeep Wagoneer (center), and Ford Bronco II.

UREA

MANUFACTURERS*

American Cyanamid Co.
Borden Chemical Co., The
Celanese Engineering Resins
Chembond Corp.
Dan River, Inc.
Georgia-Pacific Corp.
Grifftex Chemicals, Inc.
Guardsman Chemicals, Inc.
Maplechem, Inc.
Monsanto Co.
Perkins Industries
Perstorp U.S., Inc.
Pioneer Plastics Corp.
Plastics Manufacturing Co.
Reichhold Chemicals, Inc.
Valchem Div. United Merchants, Inc.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1985.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	821	809
1977	963	951
1978	1,122	1,103
1979	1,367	1,355
1980	1,165	1,147
1981	1,165	1,139
1982	998	976
1983	1,172	1,167
1984	1,199	1,189
1985	1,210	1,203
COMPOUND GROWTH RATE		
1975–1985	5.7%	5.8%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE

1976	2.85
1977	2.90
1978	3.00
1979	3.34
1980	3.11
1981	2.94
1982	2.66
1983	2.76
1984	2.63
1985	2.53

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MELAMINE

MANUFACTURERS*

American Cyanamid Co.
American Hoechst Corp.
Borden Chemical Co., The
Celanese Engineering Resins
Chembond Corp.
Formica Corp.
Grifftex Chemicals, Inc.
Maplechem, Inc..
Monsanto Co.
Owens-Corning Fiberglas Corp.
Perstorp U.S., Inc.
Pioneer Plastics Corp.
Plastics Manufacturing Co.
Reichhold Chemicals, Inc.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1985.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	186	182
1977	200	203
1978	202	196
1979	200	192
1980	167	166
1981	179	175
1982	158	155
1983	180	181
1984	210	197
1985	192	194
COMPOUND GROWTH RATE		
1975–1985	5.2%	5.2%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE

1976	0.64
1977	0.62
1978	0.53
1979	0.47
1980	0.45
1981	0.45
1982	0.42
1983	0.43
1984	0.44
1985	0.41

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

UREA AND MELAMINE

DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

END-USE	1981	1982	1983	1984	1985
Textile treating & coating resins	n.a.	n.a.	n.a.	23	17
Paper treating & coating resins	73	68	74	98	100
Bonding & adhesive resins for:					
Laminating	32	27	40	44	45
Plywood	74	64	63	59	57
Fibrous & granulated wood	884	759	918	944	955
Protective coatings	69	64	76	84	89
All other uses	158	132	155	134	134
Total	1,290	1,114	1,326	1,386	1,397

n.a.=not available

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION OF UREA/MELAMINE BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	*	*	*	*	*
Packaging	*	44	45	32	30
Building/Construction	820	712	844	896	1,009
Electrical/Electronic	*	*	*	*	*
Furniture/Furnishings	181	148	*	*	43
Consumer & institutional	48	*	*	*	116
Industrial/Machinery	*	—	—	—	—
Adhesives, Inks & Coatings	90	65	*	*	*
All Other	151	145	438	458	199
Exports	24	17	21	*	*
Total	1,314	1,131	1,348	1,386	1,397

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

UREA AND MELAMINE

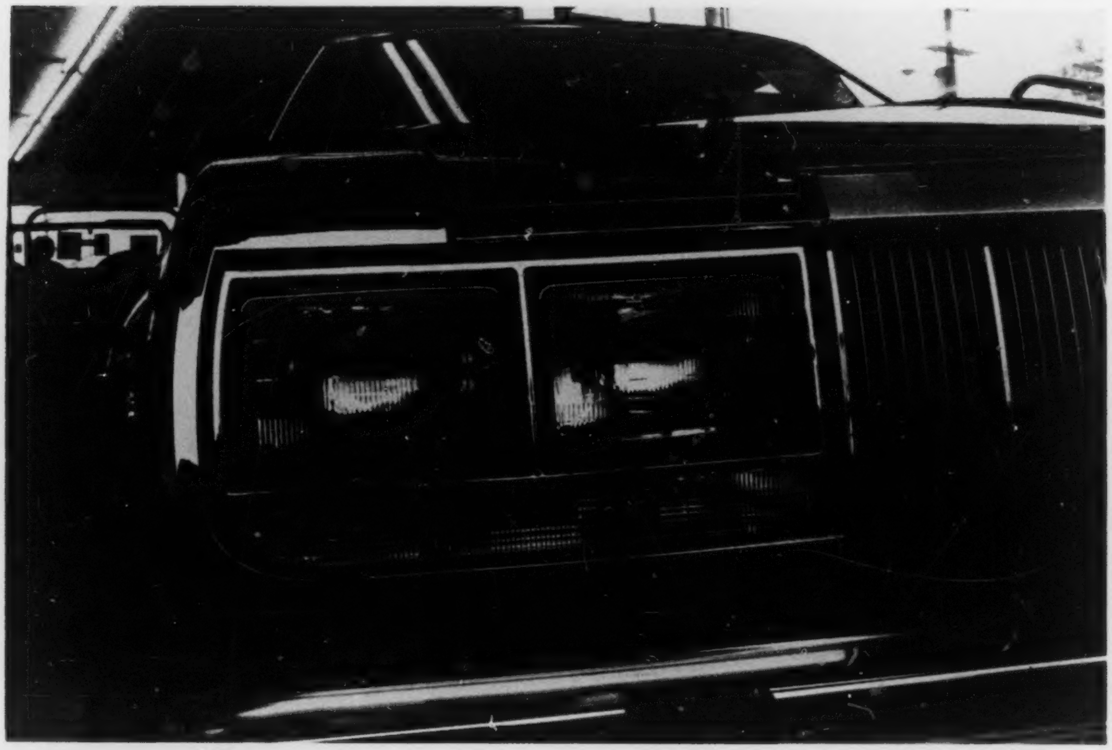
TYPICAL APPLICATIONS

UREA

Wiring devices
Toilet seats
Handles
Buttons
Knobs
Adhesives and bonding

MELAMINE

Adhesives and bonding
Buttons
Handles
Dinnerware
Knobs
Ashtrays



Automotive trim is a typical end use application for melamine resins.

MISCELLANEOUS THERMOSETS

(in millions of pounds)

PRODUCTION

Resin	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Alkyds	726	674	705	753	754	755	703	717	523	719	783
Furfuryl-type	4	8	8	n.a.	17	31	25	24	20	18	24
Silicones	18	12	15	18	16	20	12	17	13	16	16
Other[1]	33	18	26	91	60	70	169	107	125	135	138

SALES

Resin	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Alkyds	403	380	471	434	415	408	392	420	284	427	450
Furfuryl	4	n.a.	n.a.	n.a.	16	30	25	23	18	18	24
Silicones	13	8	13	11	11	11	8	8	8	9	14
Other[1]	19	21	24	70	49	61	121	78	104	114	148

n.a. = not available.

[1] Includes acetone-formaldehyde, glyoxal-formaldehyde, polybutadiene, thiourea, dicyandiamide and other thermosets.

Source: *Synthetic Organic Chemicals*, U.S. International Trade Commission.

DISTRIBUTION OF POLYURETHANE FOAM SALES AND USE BY MAJOR MARKET

(in millions of pounds)

	Quantity					% of Total				
	1981	1982	1983	1984	1985	1981	1982	1983	1984	1985
Transportation	268	248	301	330	400	15.4	14.8%	15.8%	16.1%	18.8%
Flexible	227	216	269	300	350	13.0	12.9	14.1	14.6	16.4
Rigid	41	32	32	30	50	2.4	1.9	1.7	1.5	2.4
Packaging	77	77	85	90	80	4.4	4.6	4.3	4.4	3.8
Flexible	35	34	38	40	35	2.0	2.0	2.0	2.0	1.7
Rigid	42	43	47	50	45	2.4	2.6	2.3	2.4	2.1
Furniture/Furnishings	898	859	872	895	790	51.5	51.3	45.7	43.7	37.1
Flexible	882	838	856	875	775	50.6	49.8	44.8	42.7	36.4
Rigid	16	21	16	20	15	0.9	1.5	0.9	1.0	0.7
Building/Construction	328	328	379	400	430	18.8	19.6	19.9	19.5	20.2
Electrical/Electronic	76	80	87	100	125	4.4	4.8	4.6	4.8	5.8
All Other	97	82	185	235	305	5.5	4.9	9.7	11.5	14.3
Total	1,744	1,674	1,909	2,050	2,130	100.0%	100.0%	100.0%	100.0%	100.0%

POLYURETHANE FOAM—DOMESTIC SALES & CAPTIVE USE

(in millions of pounds)

	1981	1982	1983	1984	1985	Compound Growth Rate 1980–1985
Flexible and Semi-Flexible Foam						
Bedding (excluding sofa beds)	143	125	149	165	150	1.5%
Furniture	437	431	503	500	500	3.0
Packaging	35	34	38	40	35	8.8
Rug and Underlay	165	141	165	170	125	− 4.9
Textile Laminates	36	34	39	40	35	− 1.6
Transportation	227	216	269	300	350	7.6
Miscellaneous	40	43	35	45	60	0.7
Scrap	101	103	113	140	125	9.4
Total Flexible and Semi-Flexible Foam	1,184	1,127	1,311	1,400	1,380	3.3%
Rigid Foam						
Appliances	76	80	87	100	125	12.6%
Building Construction	328	328	379	400	430	6.4
Furniture	16	21	16	20	15	− 7.4
Marine Flotation	15	12	10	10	10	− 7.8
Packaging	42	43	47	50	45	5.8
Transportation	41	32	32	30	50	1.7
Miscellaneous	42	31	27	40	75	14.6
Total Rigid Foam	560	547	598	650	750	6.8%
Grand Total Foam	1,744	1,674	1,909	2,050	2,130	4.5%

Source: SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

[a] Industry Estimates

ISOCYANATES

(in millions of pounds)

	PRODUCTION			SALES & CAPTIVE USE
Year	Total	TDI*	Other Isocyanates	Total
1981	1,147	537	610	1,138
1982	1,042	547	495	1,052
1983	1,156	624	532	1,135
1984	1,331	680	651	1,312
1985	1,312	629	683	1,294

*Toluene Diisocyanate (80/20 mixture)

POLYETHER POLYOLS

(in millions of pounds)

Year	Production	Sales & Captive Use
1981	1,264	1,266
1982	1,111	1,209
1983	1,296	1,286
1984	1,347	1,305
1985	1,391	1,407

POLYESTER POLYOLS

(in millions of pounds)

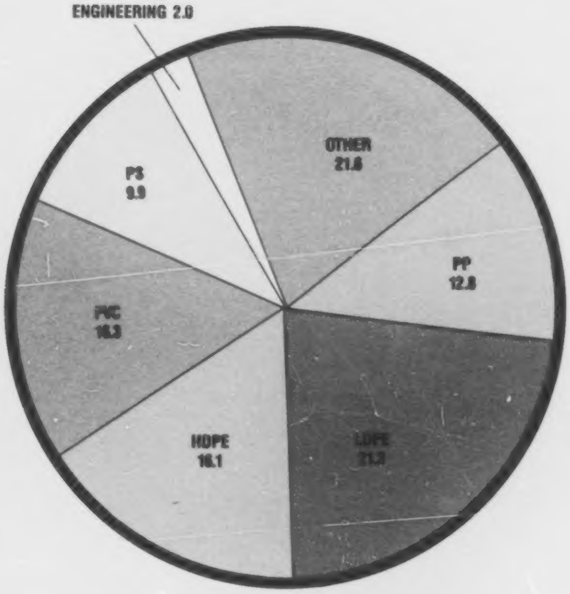
Year	Production	Sales & Captive Use
1981	47	46
1982	28	28
1983	29	26
1984	26	26
1985	41	40

PARTICIPATING COMPANIES—1985	Isocyanates	Polyether Polyols	Polyester Polyols
BASF Wyandotte Corp.	X	X	
Chemetic Systems			
Choate Chemical		X	
Dow Chemical U.S.A.	X	X	
E.I. duPont de Nemours & Co.		X	
ICI Americas	X		
Inolex Chemical			X
Mobay Chemical Corp.		X	X
Olin Corp.	X	X	
Owens-Corning Fiberglas Corp.		X	
Pioneer Plastics			X
PPG Industries		X	
Q.O. Chemical		X	
Reichhold Chemicals, Inc.		X	
Ruco Div. Occidental Chemicals Corp.			X
Stepan Chemical Co.		X	
Texaco, Inc.		X	
U.C.T., Inc.			
Union Carbide Corp.		X	X
Uniroyal Chemical Co.			X
Witco Chemical Co.		X	X

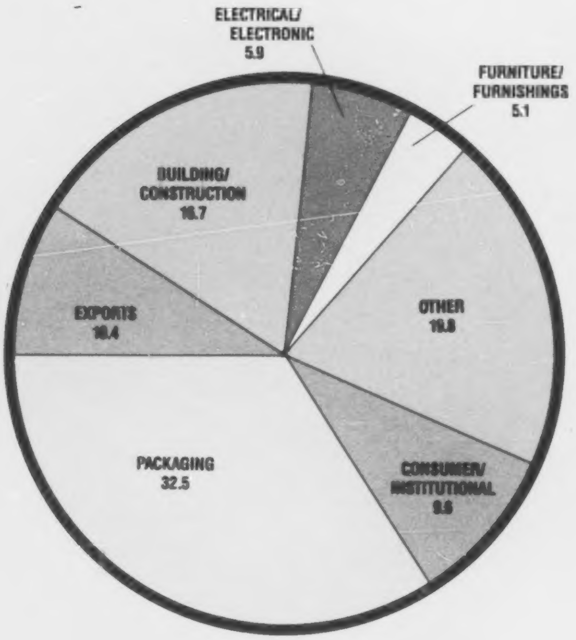
Source: Quarterly Polyols and Isocyanates Reports, SPI Committee on Resin Statistics as compiled by Ernst & Whinney.

THERMOPLASTIC RESINS

Plastics which in their final state as finished articles are capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature and physical change.



1985 PERCENT OF THERMOPLASTIC SALES & CAPTIVE USE BY MATERIAL



1985 PERCENT OF THERMOPLASTIC SALES & CAPTIVE USE BY MAJOR MARKET

ABS AND SAN

MANUFACTURERS*

Borg Warner Chemicals
Dow Chemical U.S.A.
B.F. Goodrich Chemical Co.
W. R. Grace & Co.
Monsanto Company

*Those companies who participated in the SPI Monthly Statistical Report in 1985.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION ABS	PRODUCTION SAN	SALES & CAPTIVE USE ABS	SALES & CAPTIVE USE SAN
1976	988	113	925	104
1977	1,069	115	1,057	113
1978	1,134	120	1,118	121
1979	1,191	124	1,183	126
1980	920	111	916	103
1981	916	107	900	105
1982	740	91	737	85
1983	n.a.	93	n.a.	91
1984	1,128	99	1,098	88
1985	1,028	87	1,016	84
COMPOUND GROWTH RATE				
1975–1985	4.8%	-2.2%	5.1%	1.1%

n.a. = not available.

PERCENT OF TOTAL U.S. SALES & CAPITAL USE

	ABS	SAN
1976	3.26	0.37
1977	3.23	0.34
1978	3.04	0.33
1979	2.91	0.31
1980	2.48	0.28
1981	2.32	0.27
1982	2.01	0.23
1983	n.a.	0.22
1984	2.43	0.19
1985	2.14	0.18

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION OF ABS & SAN BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1981	1982	1983[a]	1984	1985
Transportation	177	156	267	267	269
Packaging	29	*	51	13	*
Building/Construction	194	124	197	*	134
Electrical/Electronic	209	203	246	269	241
Furniture/Furnishings	*	*	7	*	*
Consumer & Institutional	165	129	168	*	*
Industrial/Machinery	*	*	47	*	*
Adhesives, Inks & Coatings	—	—	27	*	*
All Other	165	153	175	638	456
Exports	66	57	144	*	*
Total	1,005	822	1,329	1,187	1,100

*Included in all other [a]Includes Other Styrene Based Polymers

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

ABS AND SAN

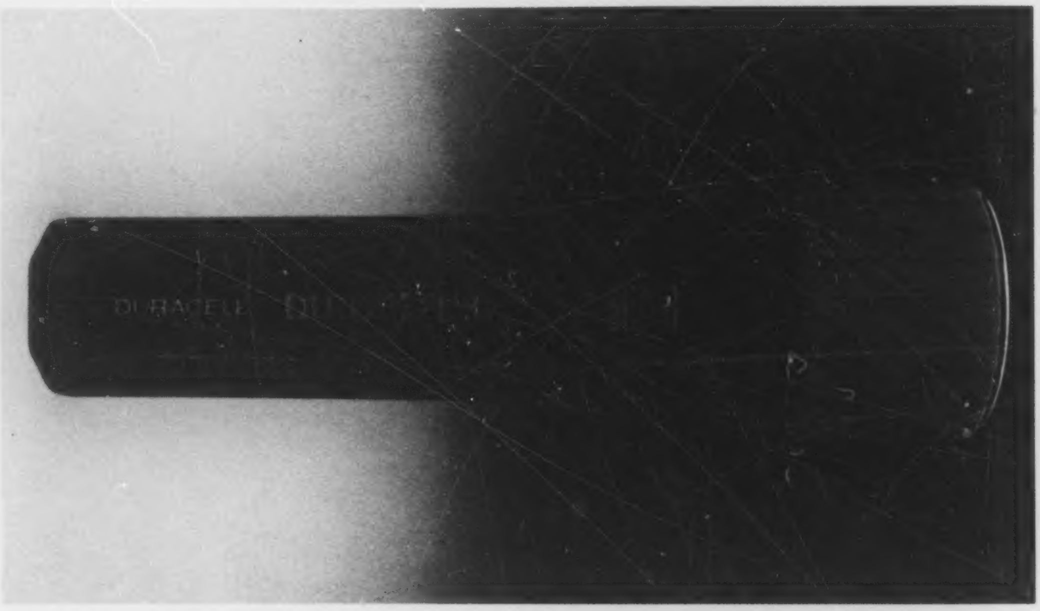
TYPICAL APPLICATIONS

ABS

- Household appliances
- Telephones
- Bath tubs
- Business machines
- Refrigerator liners
- Sporting goods

SAN

- Automotive trim
- Marine instruments
- Tractor components
- Boat hulls
- Solar collectors
- Swimming pool components

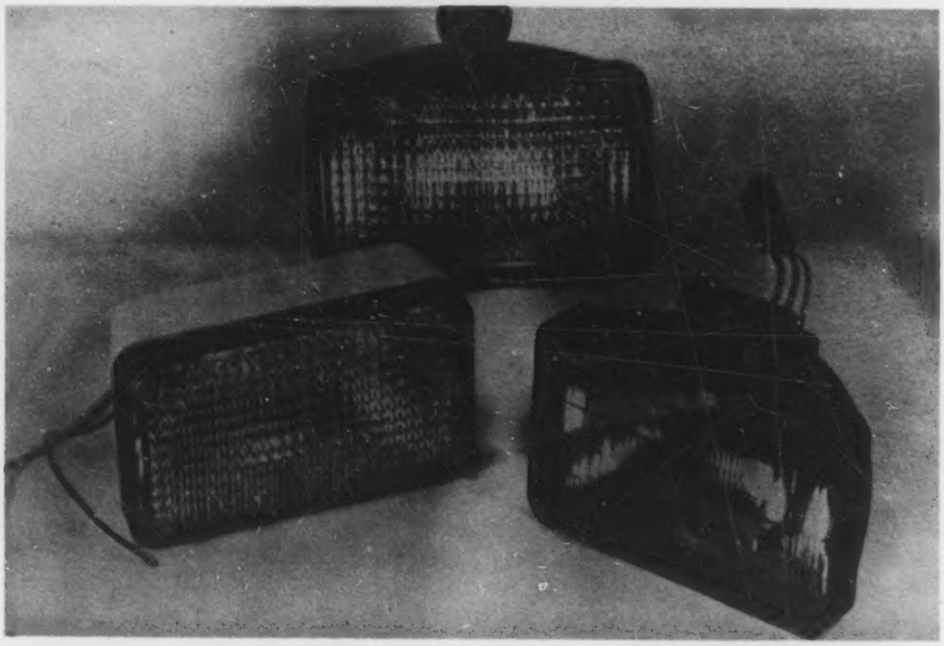


Duracell U.S.A., a division of Duracell, Inc., uses Lustran ABS resin by Monsanto Company for the molded exterior of its new Durabeam regular size flashlight.

ENGINEERING THERMOPLASTIC RESINS

TYPICAL APPLICATIONS

Acetal (AC)	Fasteners, knobs, bushings, bearings, faucets, valves, seat belt components, conveyor belts, zippers, disposable lighter bodies.
Fluoropolymers	Wire & cable jacketing, nonstick coatings, bearing pads, laminates.
Polycarbonate (PCO)	Microwave cookware, filter housings, bottles, lamp housings, drapery fixtures, safety glazing, nameplates, food processor bowls.
Polyphenylene Sulfide (PPS)	Pumps, hair dryers, small cooking appliances, automotive components.
Thermoplastic Polyester (TP)	Lighting, microwave cookware, bearings, beverage bottles, food containers, auto grilles, switches.
Polysulfone (PSO)	Food processing equipment, circuit boards, camera and watch cases, purification devices, connectors.
Modified Polyphenylene Oxide (PPO)	Personal computers, auto instrument panels, wheel covers, pump housings, radomes, fuse boxes, TV cabinetry.
Polyimide (PI)	Printed wiring boards, gears, electric motors, radomes, bearings.
Polyimide-imide (PAI)	Seals, valve train components, jet engine components, transmissions.



High heat distortion capability, with an excellent balance of other mechanical properties and moderate cost, sparked the selection of Petlon, a modified polyethylene terephthalate (PET), for sealed-beam halogen headlamp housings.

The 35 percent mineral-filled and glass-fiber-reinforced thermoplastic, Petlon 7530, is manufactured by Mobay Chemical Corporation.

ENGINEERING THERMOPLASTIC RESINS

MANUFACTURING

KNOWN MANUFACTURERS	AC	PCO	PPS	TP	PSO	PPO	PI	PAI	FLUORO-POLYMERS
Allied				X					X
American Hoechst				X					
Amoco Chemical							X	X	
Celanese Engineering Resins	X			X					
Dow Chemical		X							
Dupont	X			X			X		X
Eastman Chemical				X					
GAF				X					
General Electric		X		X		X	X		
Goodyear				X					
ICI Americas									X
Mobay Chemical		X		X					
Pennwalt Corp.									X
Phillips Petroleum			X						
Union Carbide					X				

PRODUCTION AND SALES & CAPTIVE USE[1]

(in millions of pounds and dollars)

YEAR	PRODUCTION	SALES & CAPTIVE USE	SALES (EXCL. CAPTIVE & EXPORTS)
1977	605	576	$486
1978	648	639	579
1979	729	709	699
1980	673	645	715
1981	676	633	806
1982	569	596	755
1983	731	781	979
1984	878	892	1,148
1985	834	839	1,107

COMPOUND GROWTH RATE OF SALES & CAPTIVE USE	
1975–1985	6.9%
1980–1985	5.4%
1984–1985	– 6.0%

Source: SPI Committee on Resin Statistics as compiled by Ernst & Whinney

[1] Excludes thermoplastic polyester resins.

DISTRIBUTION BY MAJOR MARKET[1]

(in millions of pounds)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	76	80	123	136	140
Packaging	1	1	2	2	14
Building & Construction	96	82	76	101	79
Electrical/Electronic	211	192	275	305	250
Consumer/Institutional	37	45	82	90	28
Industrial/Machinery	58	52	75	88	37
Other	34	18	26	70	88
Exports	120	126	122	100	203
Total	633	596	781	892	839

Source: SPI Committee on Resin Statistics Annual Major Markets Survey & Industry estimates.

[1] Excludes thermoplastic polyester

U.S. SALES OF FLUOROPOLYMER RESINS (GRANULAR TYPE ONLY)

(in thousands of pounds)

	1981	1982	1983	1984	1985
Virgin, First Quality	7,699	5,651	6,898	7,969	7,406
Filled Resin, including colors	3,265	2,283	3,131	4,061	4,006
Miscellaneous lubricants, release compounds, etc.[1]	3,503	2,493	2,524	3,034	3,549
Total	14,467	10,427	12,553	15,064	14,961

[1] Includes broad specification second quality.

Source: SPI's Fluoropolymers Division.

COMPOUND GROWTH RATE
1980–1985

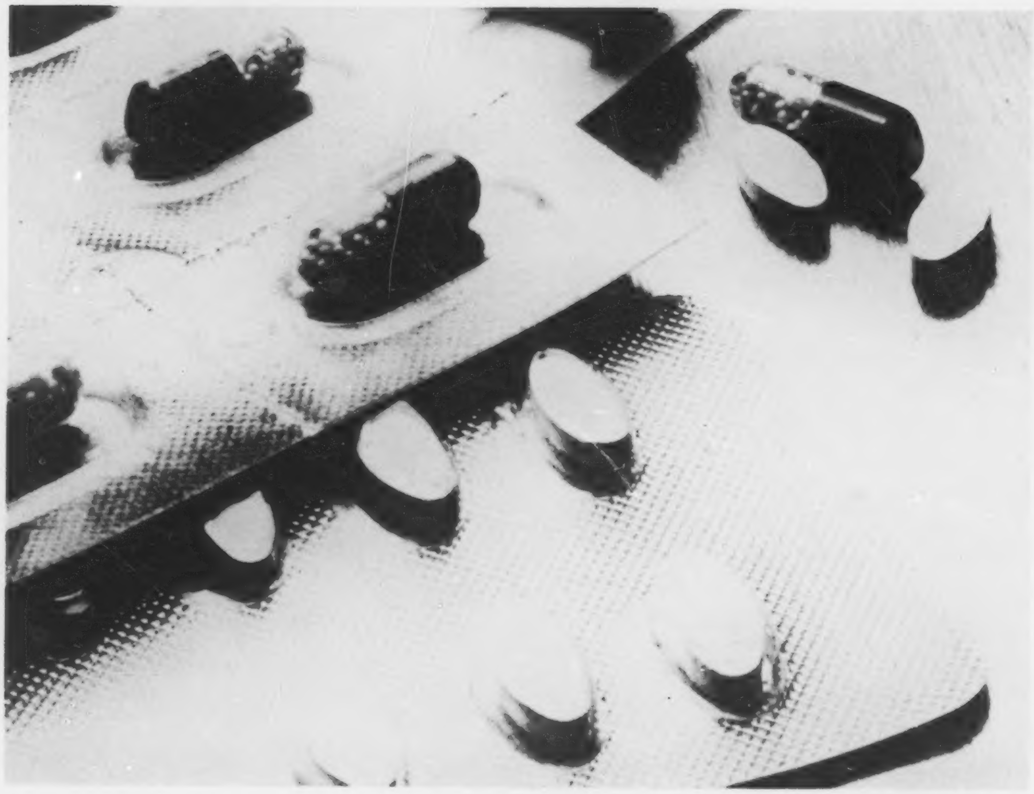
Virgin, First Quality	0.2%
Filled resin, including colors	7.1%
Miscellaneous lubricants, release compounds, etc.	1.2%
Total	2.1%

SUPPLIERS OF GRANULAR PTFE RESINS

Allied Chemical Corp.
American Hoechst Corp.
Custom Compounding
E.I. duPont de Nemours & Co.
ICI Americas
LNP Corporation
Mikro Technik
Montedison USA

FLUOROPOLYMERS
TYPICAL APPLICATIONS

- Plenum cable
- Non-stick coatings
- Wire ties
- Chemical processing equipment
- Filter housings
- Valves
- Electrical components
- Tower packings
- Heat-shrinkable tubing



ACLAR® Fluorohalocarbon flexible film has excellent chemical and moisture barrier properties. It is ideal for specialty and military packaging, barrier construction and product fabrication. The film is supplied by Allied-Signal Corporation.

HIGH DENSITY POLYETHYLENE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31:[1] (millions of pounds) 1985	1986
Allied Corp.	850	850
American Hoechst Corp.	250	250
Amoco Chemicals Corp.	340	340
Chevron Chemical Co.	570	570
Enron Chemical (formerly Norchem)[2]	250-350	250-350
Dow Chemical U.S.A.	420	420
DuPont, E.I. de Nemours & Co.	900	900
Exxon Chemical USA[2]	0-600	0-600
Himont U.S.A.	30	30
Mobil Chemical Co.[2]	400-500	400-500
Phillips Petroleum Co.	1,400	1,400
Soltex Polymers	950	950
Union Carbide Corp.[2]	400-1,600	600-1,800
U.S. Industrial Chemicals Co.	800-1,000	800-1,000
Total[2]	7,560-9,760	7,760-9,960

[1] Includes dual HDPE/LLDPE capacity.

[2] Range takes into account swing capacity between HDPE/LLDPE.

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1976	79.9
1977	84.8
1978	85.8
1979	94.1
1980	74.4
1981	78.3
1982	76.5
1983	82.6
1984	82.9
1985	76.8

PRODUCTION AND SALES & CAPTIVE USE
(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	3,125	3,127
1977	3,652	3,557
1978	4,201	4,165
1979	5,010	4,893
1980	4,405	4,394
1981	4,695	4,683
1982	4,928	5,024
1983	5,691	5,707
1984	6,085	5,949
1985	6,671	6,651
Compound Growth Rate 1975-1985	10.4%	11.2%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1976	11.02
1977	10.85
1978	11.31
1979	12.05
1980	11.91
1981	12.07
1982	13.71
1983	13.52
1984	13.16
1985	14.01

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

HIGH DENSITY POLYETHYLENE
DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

END-USE	1981	1982	1983	1984	1985
Film (12 mils & below)	281	288	375	371	437
Sheet (over 12 mils)	52	64	76	121	140
Injection molding	997	1,102	1,188	1,191	1,538
Wire & cable	111	110	112	123	113
Extrusion coating	33	16	n.a.	n.a.	n.a.
Blow molding	1,696	1,714	1,808	2,079	2,245
Pipe & conduit	408	395	471	473	478
Other extruded products	18	25	42	45	36
All other uses	626	633	634	850	787
Total	4,222	4,347	4,706	5,253	5,774

n.a.=not available.
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

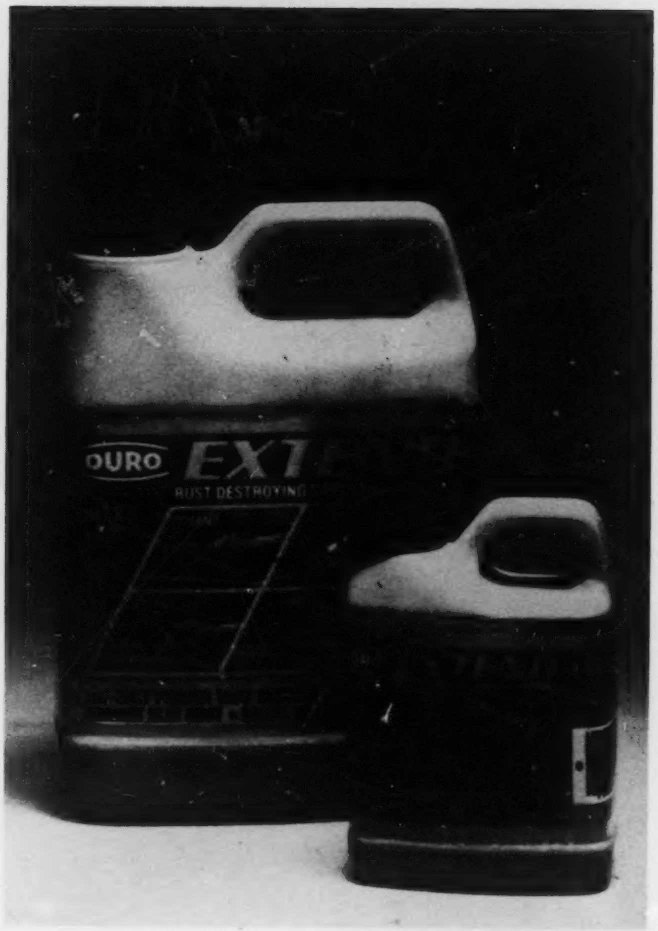
MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	63	49	121	*	183
Packaging	2,367	2,565	2,591	2,954	3,355
Building/Construction	486	441	518	513	546
Electrical/Electronic	146	142	123	149	153
Furniture/Furnishings	*	*	*	*	46
Consumer & Institutional	482	421	526	488	507
Industrial/Machinery	102	95	109	161	141
Adhesives, Inks & Coatings	*	*	*	*	—
All Other	576	634	718	988	843
Exports	461	677	1,001	696	877
Total	4,683	5,024	5,707	5,949	6,651

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

HIGH DENSITY POLYETHYLENE

TYPICAL APPLICATIONS

- Grocery bags
- Bottles
- Agricultural tanks
- Florist tissue
- Cables
- Gasoline tanks
- 55-gal. drums
- Shipping containers
- Seating



These F-style industrial bottles are molded from HDPE applied by Soltex Polymer Corporation.

LATEX MATERIALS

SIGNIFICANT PRODUCERS*

American Synthetic Rubber
Dow Chemical
General Tire & Rubber
Goodyear Tire & Rubber
W.R. Grace
Morton Chemical
Polysar Corp.
Reichhold Chemicals
Union Chemical

* Those producers in the SPI statistical report.

Production by product type and end-use is as follows:

PRODUCT TYPE	APPROXIMATE % OF TOTAL
Polyvinyl acetate homopolymers and copolymers	48
Styrene/butadiene polymers	45
All other	7
	100

END-USE	APPROXIMATE % OF TOTAL	
Export	1	
Domestic	99	
Paint & coatings		17
Adhesives, caulks, sealants		17
Paper treating		2
Paper coating		26
Textile treating		2
Carpet backing		20
Nonwoven		4
Other		11
	100	

STYRENE BUTADIENE & OTHER STYRENE BASED LATEXES

Significant producers are: Dow, General Tire & Rubber, Goodyear, W.R. Grace, Morton Industries, Polysar, Reichhold and Union Chemical.

PRODUCTION AND SALES & CAPTIVE USE
(thousands of pounds)

		SALES & CAPTIVE USE*				
Year	Production	Paper Treating	Textile Treating	Carpet Backing	All Other	Total
1981	674,188	32,024	28,152	258,740	331,617	650,533
1982	510,160	24,211	12,829	199,461	267,760	504,261
1983	701,673	26,884	19,438	298,649	353,773	698,744
1984	745,109	24,400	15,483	315,811	393,302	748,996
1985	736,163	39,064	17,026	304,370	429,609	790,069

* Data may not be comparable due to variations in participation.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics as compiled by Ernst & Whinney.

LOW DENSITY POLYETHYLENE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31[1]: (millions of pounds) 1984	1985
Chevron Chemical Co.	900	900
Dow Chemical U.S.A.	1,700	1,700
DuPont, E.I. de Nemours & Co.	700	700
Eastman Chemical Products	600	600
El Paso Chemical Co.	400	400
Enron Chemical (formerly Norchem)	1,200	1,200
Exxon Chemical U.S.A.[2]	1,150-1,300	1,100-1,200
Mobil Chemical Co.	500	500
Union Carbide Corp.[2]	1,950-2,100	1,800-2,000
U.S. Industrial Chemicals Co.	800	800
Total[2]	9,900-10,200	9,700-10,000

[1] Includes Linear Low Density

[2] Range takes into account dual HDPE/LLDPE capacity not dedicated.

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1976	82.9
1977	81.8
1978	88.9
1979	97.7
1980	86.1
1981	78.8
1982	80.2
1983	93.0
1984	82.3
1985	86.7

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	5,813	5,765
1977	6,471	6,488
1978	7,111	7,147
1979	7,793	7,815
1980	7,291	7,467
1981	7,693	7,516
1982	7,503	7,687
1983	8,041	8,045
1984	8,413	8,416
1985	8,899	8,790
Compound Growth Rate 1975-1985	6.5%	6.4%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1976	20.31
1977	19.80
1978	19.41
1979	19.25
1980	20.24
1981	19.37
1982	20.98
1983	19.06
1984	18.61
1985	18.52

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

LOW DENSITY POLYETHYLENE
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

END-USE	1981	1982	1983	1984	1985
Film (12 mils & below)	4,077	4,209	4,628	4,689	4,777
Sheet (over 12 mils)	14	18	n.a.	n.a.	n.a.
Injection molding	524	507	657	612	583
Wire & cable	347	278	310	368	337
Extrusion coating	564	544	573	640	649
Blow molding	60	42	42	43	47
Pipe & conduit	25	23	25	27	28
Other extruded products	60	46	92	95	103
All other uses	862	876	800	968	1,136
Total	6,533	6,543	7,127	7,442	7,660

n.a.=not available

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	53	*	*	*	*
Packaging	4,602	4,623	5,377	5,393	5,469
Building/Construction	148	225	226	313	327
Electrical/Electronic	431	345	374	430	403
Furniture/Furnishings	15	*	*	4	37
Consumer & Institutional	598	487	560	666	468
Industrial/Machinery	*	*	*	*	*
Adhesives, Inks & Coatings	*	46	*	67	111
All Other	685	817	589	569	844
Exports	984	1,144	919	974	1,131
Total	7,516	7,687	8,045	8,416	8,790

* Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

LOW DENSITY POLYETHYLENE

TYPICAL APPLICATIONS

- Stretch wrap
- Diaper liners
- Household cling wrap
- Squeeze bottles
- Housewares
- Lids
- Closures
- Pipe
- Toys

Among the film uses for low and linear low density polyethylene are garbage and refuse bags. These resins are supplied by U.S. Industrial Chemicals Company.

NYLON

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31: (millions of pounds) 1985	1986
Allied Corp.	100	100
ATOCHEM (formerly Rilsan)	22	31
BASF Corp..	20	20
Belding Chemical Industries	6	6
Celanese Engineering Resins Co.	40	40
Custom Resins, div. Bemis Co.	20	20
DuPont, E.I. de Nemours & Co.	215	230
Emser Industries	10	10
Monsanto Company	80	80
Nylon Corp. of America	22	22
Shakespeare Co.	4	4
Wellman, Inc.	24	24
Total	563	587

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1976	80.2
1977	70.8
1978	74.5
1979	79.8
1980	64.0
1981	70.6
1982	53.1
1983	74.7
1984	77.5
1985	70.9

PRODUCTION AND SALES & CAPTIVE USE
(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	247	221
1977	254	250
1978	275	278
1979	327	315
1980	274	271
1981	312	288
1982	228	247
1983	321	329
1984	396	389
1985	399	403
COMPOUND GROWTH RATE		
1975-1985	11.5%	10.9%

NYLON

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1976	0.78
1977	0.76
1978	0.76
1979	0.78
1980	0.73
1981	0.74
1982	0.67
1983	0.78
1984	0.86
1985	0.85

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE

(in thousands of pounds)

END-USE	1981	1982	1983	1984	1985
Automotive and truck	89,115	69,909	109,949	147,500	166,232
Electrical and Electronic[1]	32,857	28,870	36,144	45,247	42,286
Appliances	8,549	6,847	6,804	6,752	7,559
Film and Coating	28,740	31,879	40,156	43,014	41,698
Wire and Cable	18,999	15,898	18,733	20,913	21,093
Monofilament	15,593	10,126	15,184	15,283	16,006
Consumer[2]	16,533	14,967	20,187	19,547	20,930
Industrial/Machinery	n.a.	13,733	27,853	34,111	31,931
Others	59,159	38,296	30,043	30,978	30,739
Total	269,545	230,525	305,053	363,345	378,474

[1] Includes electrical and electronic applications not assignable to automotive and truck or appliance markets.
[2] Includes such items as housewares, brushes, combs, sporting goods, cameras and toys.
n.a. = not available.
Source: SPI Committee on Resin Statistics, as complied by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	92	74	109	156	180
Packaging	32	33	40	38	*
Building/Construction	*	*	*	*	*
Electrical/Electronic	57	50	60	73	67
Furniture/Furnishings	8	*	9	6	5
Consumer & Institutional	17	13	*	*	*
Industrial/Machinery	26	21	28	38	32
Adhesives, Inks & Coatings	*	*	*	*	*
All Others	37	38	59	52	95
Exports	19	18	24	26	24
Total	288	247	329	389	403

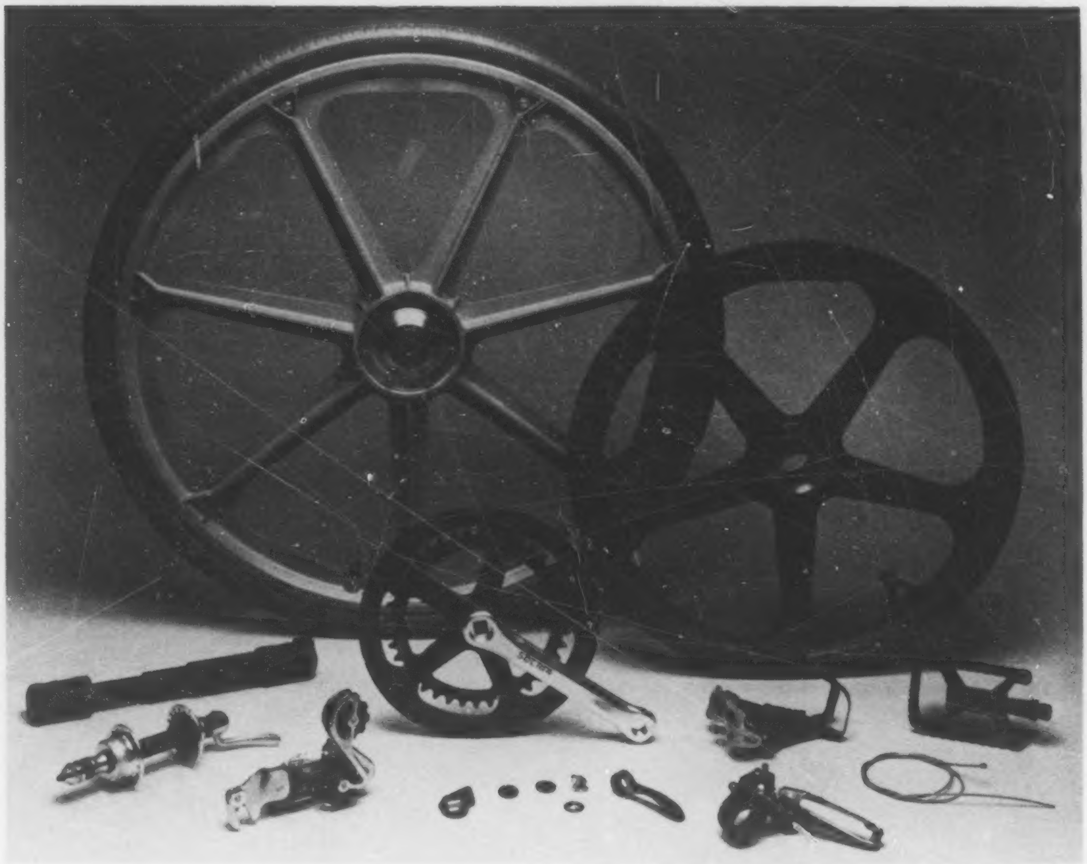
*Included in all other.

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

NYLON

TYPICAL APPLICATIONS

- Electrical connectors
- Fender extensions
- Brush bristles
- Wire jackets
- Power tool housings
- Fishing line
- Emission cannisters
- Cooking bags
- Sutures



Trend to engineering plastics in bicycle parts benefits glass reinforced "Zytel" nylon resin. Commercial applications on worldwide basis include pedals, wheels, wheel hubs, brake and gear shifting levers, and main drive sprocket. Resins are supplied by E.I. du Pont de Nemours & Co., Inc.

POLYPROPYLENE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31: (millions of pounds) 1985	1986
Amoco Chemicals Co.	1,000	1,000
Eastman Chemical Products, Inc.	140	140
El Paso Chemical Co.	325	350
Exxon Chemical U.S.A.	550	550
Fina Oil & Chemical	450	450
Himont U.S.A.	1,325	1,425
Norchem	240	240
Phillips Petroleum Company	250	250
Shell Chemical Company	800	800
Soltex Polymer Corp.	220	260
USS Chemicals Co.	500	500
Total	5,800	5,965

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1976	83.0
1977	82.5
1978	66.8
1979	76.3
1980	70.2
1981	78.2
1982	68.3
1983	84.1
1984	87.8
1985	86.1

PRODUCTION AND SALES & CAPTIVE USE
(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	2,632	2,536
1977	2,747	2,698
1978	3,074	3,055
1979	3,841	3,894
1980	3,648	3,714
1981	3,955	3,888
1982	3,477	3,623
1983	4,434	4,464
1984	4,940	4,816
1985	5,139	5,275
COMPOUND GROWTH RATE 1975-1985	10.4%	10.7%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYPROPYLENE

	PERCENT OF TOTAL U.S. SALES & CAPTIVE USE
1976	8.94
1977	8.23
1978	8.30
1979	9.59
1980	10.07
1981	10.02
1982	9.89
1983	10.58
1984	10.65
1985	11.11

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

END-USE	1981	1982	1983	1984	1985
Injection molding, total	1,243	1,073	1,232	1,290	1,274
Appliances	94	72	96	121	114
Consumer products	359	273	301	292	310
Rigid packaging	266	291	351	360	387
Transportation	247	225	293	316	340
All other injection molding	277	212	191	201	123
Blow molding	65	68	90	105	105
Film (10 mils & below)	303	290	364	401	389
Sheet	35	19	33	52	44
Other extruded products (including wire & cable, pipe & conduit, and extrusion coating)	99	93	106	112	89
Fiber & filaments	1,036	866	1,221	1,338	1,433
All other uses	421	476	618	736	1,066
Total	3,202	2,885	3,664	4,034	4,400

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as complied by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	266	199	293	233	230
Packaging	812	757	845	901	1,000
Building/Construction	*	31	22	36	*
Electrical/Electronic	248	161	242	289	273
Furniture/Furnishings	813	772	983	1,123	1,119
Consumer & Institutional	487	421	580	624	621
Industrial/Machinery	56	*	*	*	11
Adhesives, Inks & Coatings	*	*	*	*	*
All Other	521	545	699	828	1,146
Exports	685	737	800	782	875
Total	3,888	3,623	4,464	4,816	5,275

*Included in all other.

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYPROPYLENE
TYPICAL APPLICATIONS

- Retort pouches
- Tobacco wrap
- Bottles
- Battery cases
- Carpet backing
- Threaded caps
- Filter plates
- Toys
- Microwave oven containers

McCORMICK
McCORMICK
FRIED
Chicken
Seasoning

McCormick spices now appear across the nation in polypropylene bottles molded by Setco Inc., a subsidiary of McCormick & Company. The switch from glass to plastic eliminated breakage and reduced noise and shipping charges. The bottles are injection blow molded of Marlex polypropylene resin from Phillips 66 Company.

POLYSTYRENE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31: (millions of pounds) 1985	1986
A & E Plastic Pak	50	50
American Hoechst Corp.	455	—
Amoco Chemicals Corp.	400	400
ARCO Chemicals Co.	500	500
Asoma Chemicals, Inc.	45	45
BASF Wyandotte Corp.	180	180
Chevron Chemical Co.	400	400
Dart Container	40	40
Dow Chemical Corp.	820	850
Fina Oil & Chemical	400	400
Georgia Pacific	60	60
Huntsman Chemical Co.	580	1,000
Kama Corp	40	40
Mobil Chemical Corp.	375	375
Monsanto Company	450	655
Polysar Group	300	300
Texstyrene Plastic Co.	90	90
Vititek	5	5
Total	5,200	5,400

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1976	61.0
1977	66.7
1978	75.9
1979	77.0
1980	67.1
1981	70.2
1982	61.7
1983	68.7
1984	70.0
1985	72.2

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	3,195	3,145
1977	3,446	3,557
1978	3,823	3,870
1979	4,005	3,997
1980	3,521	3,518
1981	3,621	3,604
1982	3,191	3,200
1983	3,567	3,606
1984	3,838	3,836
1985	4,054	4,108
COMPOUND GROWTH RATE		
1975-1985	4.3%	4.5%

POLYSTYRENE

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1976	11.08
1977	10.85
1978	10.51
1979	9.84
1980	9.53
1981	9.29
1982	8.73
1983	8.54
1984	8.48
1985	8.65

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

END-USE	1981	1982	1983	1984	1985
Straight Polystyrene[a]	1,793	1,669	1,811	1,959	2,078
Rubber-Modified Polystyrene[a]	1,811	1,531	1,718	1,776	1,946
Total	3,604	3,200	3,529	3,735	4,024
Molding	1,638	1,368	1,516	1,436	1,403
Extrusion	1,142	1,060	1,238	1,468	1,737
Expandable Polystyrene Beads	416	426	440	487	521
All Other Uses	257	251	335	344	363
Total Domestic	3,453	3,105	3,529	3,735	4,024

[a] Includes exports 1981–1982

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	16	4	12	*	*
Packaging	1,494	1,288	1,486	1,540	1,292
Building/Construction	273	289	294	385	449
Electrical/Electronic	360	311	307	351	309
Furniture/Furnishings	62	39	[illegible]	26	47
Consumer & Institutional	756	745	820	754	1,090
Industrial/Machinery	*	*	*	*	*
Adhesives, Inks & Coatings	*	*	*	—	*
All Other	493	429	563	679	837
Exports	150	95	77	101	84
Total	3,604	3,200	3,606	3,836	4,108

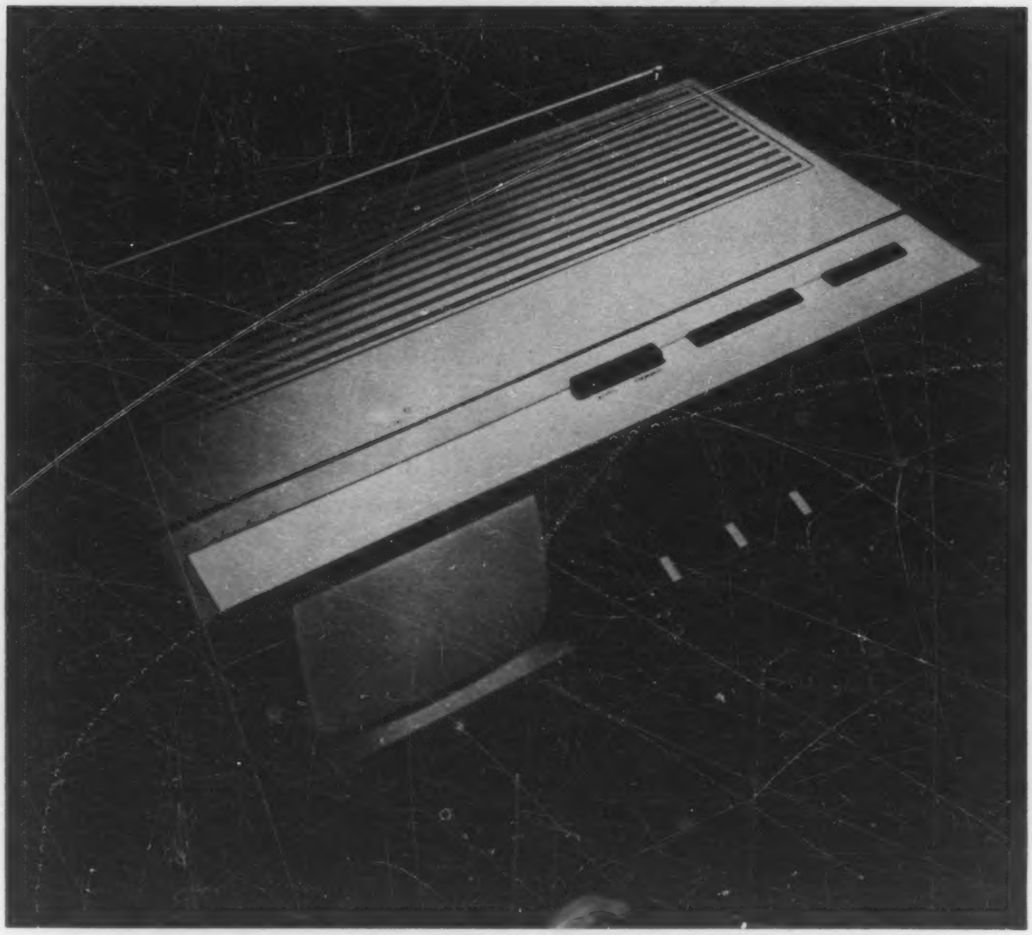
*Included in all other.

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYSTYRENE

TYPICAL APPLICATIONS

Disposable serviceware
Pallets
Trays
Video cassettes
Appliance parts
Roofing insulation
Business machines
Syringes
Egg cartons



This portable television is manufactured using Huntsman Ignition Retardant Polystyrene resin.

POLYVINYL CHLORIDE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31: (millions of pounds) 1985	1986
Air Products & Chemicals	500	500
Borden Chemical Company, The	800	800
Certain-Teed Products Corp.	220	220
Formosa Plastics	900	935
Georgia-Gulf Corp.	850	850
B.F. Goodrich Chemical Company, The	1,800	1,800
Goodyear Tire & Rubber Company, The	100	100
Keysor-Century Corp.	50	50
Occidental Chemical Co.	600	1,470
Shintech, Inc.	950	950
Tenneco Chemicals	870	—
Union Carbide Corp.	125	125
Vista Polymers	715	715
Vygen	100	100
Total	8,580	8,615

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1976	80.0
1977	82.8
1978	90.8
1979	86.3
1980	76.8
1981	75.8
1982	72.1
1983	79.2
1984	81.3
1985	80.0

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1976	4,716	4,638
1977	5,253	5,232
1978	5,723	5,810
1979	6,119	6,138
1980	5,470	5,407
1981	5,707	5,601
1982	5,326	5,455
1983	6,066	6,152
1984	6,760	6,798
1985	6,772	6,720
Compound Growth Rate 1975–1985	6.4%	6.4%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1976	16.34
1977	15.97
1978	15.78
1979	15.12
1980	14.65
1981	14.44
1982	14.89
1983	14.57
1984	15.03
1985	14.16

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYVINYL CHLORIDE
DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

End-use	1981	1982	1983	1984	1985
Calendering, total	666	594	682	720	690
Flooring	147	149	160	173	161
Textile	73	64	105	91	71
All other calendering	446	381	417	456	458
Coating, total	314	267	361	350	303
Flooring	123	99	149	146	125
Textile & paper coating	100	87	119	107	93
Protective coatings	41	38	45	43	46
Adhesives & all other coatings	50	43	48	54	39
Extrusion, total	3,149	3,129	3,496	4,330	4,481
Wire & cable	367	328	350	411	455
Film & sheet	287	312	309	350	226
Rigid pipe & tubing (except fittings)	2,033	2,014	2,273	2,901	2,809
All other extrusions	462	475	564	668	991
Molding, total	372	364	430	464	465
Bottles	92	103	166	186	163
Sound records	104	112	80	75	68
Fittings (rigid pipe & tubing)	102	99	106	122	160
All other molding	74	50	78	81	74
Paste processes (except coating), total	182	172	166	169	156
Plastisol formulation	99	85	96	93	77
All other	83	87	70	76	79
Resellers	140	147	203	167	101
All other uses	342	217	280	220	233
Grand total	5,165	4,890	5,618	6,420	6,429

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as complied by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

Major Market	1981	1982	1983	1984	1985
Transportation	177	123	150	163	141
Packaging	424	450	546	619	572
Building/Construction	2,891	2,902	3,329	4,134	4,198
Electrical/Electronic	583	467	386	398	479
Furniture/Furnishings	171	236	289	242	310
Consumer & Institutional	434	356	293	290	230
Industrial/Machinery	19	*	20	19	30
Adhesives, Inks & Coatings	56	*	77	108	89
All Other	410	355	528	447	379
Exports	436	566	534	378	292
Total	5,601	5,455	6,152	6,798	6,720

*Included in all other.

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYVINYL CHLORIDE
TYPICAL APPLICATIONS

Food wrap
Flooring
Siding
Pipe
Wall covering
Coatings
Upholstery
Garden hose
Shower curtains

Many medical products—such as intravenous bags, blood bags and tubing—are made of superclean Geon® PVC resins by such major companies as Baxtor Travanol. Geon® PVC resins are supplied by the B.F. Goodrich Chemical Company.

POLYVINYL ACETATE

There are more than 50 producers of polyvinyl acetate, supplied with monomer by such companies as Air Products & Chemicals, Borden, Celanese Chemical, H.B. Fuller, W.R. Grace, Monsanto, National Starch, Reichhold Chemicals, Rohm & Haas, Union Carbide, Unocal, and U.S. Industrial Chemicals.

SALES AND CAPTIVE USE OF VINYL ACETATE MONOMER FOR POLYVINYL ACETATE
(thousands of pounds)

Year	Emulsion Paint	Adhesives	Paper	Textile	Non-woven Binders	Others	Export	Total
1981	179,531	263,205	85,465	26,666	29,865	42,357	14,557	641,646
1982	163,470	234,994	94,185	17,250	25,700	26,143	6,081	567,823
1983	210,553	273,751	117,330	22,601	31,212	27,542	5,867	688,856
1984	203,282	275,002	119,528	25,924	30,896	28,767	6,976	690,375
1985	204,497	262,437	110,969	31,964	n.a.	58,185	6,124	674,176

COMPOUND GROWTH RATE TOTAL SALES & CAPTIVE USE	
1980–1985	–0.8%
1984–1985	–2.0%

n.a. = not available.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYVINYL ALCOHOL

The major manufacturers of polyvinyl alcohol in the U.S. are DuPont, Air Products, and Monsanto.

PRODUCTION AND SALES & CAPTIVE USE
(thousands of pounds)

		SALES & CAPTIVE USE		
YEAR	PRODUCTION	DOMESTIC	EXPORT	TOTAL
1981	138,898	114,355	20,393	134,748
1982	n.a.	n.a.	n.a.	n.a.
1983	132,176	112,230	23,827	136,057
1984	138,465	108,964	29,793	138,757
1985	138,352	114,995	30,875	145,870

COMPOUND GROWTH RATE TOTAL SALES & CAPTIVE USE	
1980–1985	2.7%
1984–1985	5.1%

n.a. = not available.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

OTHER VINYL RESINS

Producers of these vinyl resins include Dow, DuPont, W.R. Grace, Monsanto, Morton Industries, Rohm and Haas, and Unocal.

PRODUCTION AND SALES & CAPTIVE USE
(thousands of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1981	208,201	198,903
1982	177,225	166,695
1983	185,558	177,844
1984	187,209	186,619
1985	189,699	191,437

COMPOUND GROWTH RATE OF SALES & CAPTIVE USE	
1980–1985	−0.2%
1984–1985	2.6%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MISCELLANEOUS THERMOPLASTICS

(millions of pounds)

	PRODUCTION									
RESIN	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**
Acrylics	773	888	967	1,086	1,142	1,028	1,100	1,131	1,365	1,361
Petroleum hydrocarbons	299	306	334	319	321	264	272	283	257	292
Non-nylon polyamides	24	31	41	33	35	46	49	49	59	69
Polyterpenes	11	13	14	15	30	41	36	31	36	35
Rosin modifications	64	64	47	41	94	182	275	388	388	391
Other[1]	63	443	115	169	188	406	607	351	442	460

	SALES									
RESIN	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**
Acrylics	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	884	812	941	953
Petroleum hydrocarbons	281	293	332	309	301	253	259	262	227	246
Non-nylon polyamides	23	28	40	33	34	42	47	44	56	63
Polyterpenes	10	13	14	15	30	36	35	29	36	36
Rosin modifications	501	63	47	42	85	177	266	325	358	371
Other[1]	727	1,043	862	883	667	791	806	280	261	259

n.a. = not available
*Included in other

[1] Includes acrylic (sales only 1975–1980), chlorinated polyolefins, coumarone-indene, fluoropolymers, polybutylene, polyphenyl aromatic esters, and other thermoplastics. Thermoplastic polyesters were taken out in 1982.
Source: *Synthetic Organic Chemicals*, U.S. International Trade Commission.

DOMESTIC SALES & USE OF SELECTED THERMOPLASTICS BY PROCESS GRADE

(millions of pounds)

MATERIAL/YEAR	TOTAL	INJECTION MOLDING	EXTRUSION	BLOW MOLDING	OTHER
Grand Total					
1981	24,232	5,383	12,252	2,293	4,304
1982	23,259	4,979	11,665	2,383	4,232
1983	26,546	5,778	13,407	2,620	4,741
1984	29,007	5,849	14,918	2,948	5,292
1985	[illegible]0,407	6,052	15,526	3,182	5,647
Growth Rate					
1980–1985	5.7%	3.0%	5.9%	8.3%	6.5%
LD Polyethylene					
1981	6,533	524	5,087	60	862
1982	6,543	507	5,118	42	876
1983	7,127	657	5,628	42	800
1984	7,442	612	5,819	43	968
1985	7,660	583	5,894	47	1,136
Growth Rate					
1980–1985	3.9%	2.4%	3.5%	– 6.3%	7.7%
HD Polyethylene					
1981	4,222	997	903	1,696	626
1982	4,347	1,102	898	1,714	633
1983	4,706	1,188	1,076	1,808	634
1984	5,253	1,191	1,133	2,079	850
1985	5,774	1,538	1,204	2,245	787
Growth Rate					
1980–1985	8.3%	10.4	9.0%	7.4%	6.5%
Polypropylene					
1981	3,202	1,243	1,473	65	421
1982	2,885	1,073	1,268	68	476
1983	3,664	1,232	1,724	90	618
1984	4,034	1,290	1,903	105	736
1985	4,400	1,274	1,955	105	1,066
Growth Rate					
1980–1985	7.7%	2.6%	7.2%	10.8%	17.7%
A B S[a]					
1981	848	488	180	—	180
1982	689	430	111	—	148
1983	900	560	145	—	195
1984	1,000	600	150	—	250
1985	900	575	125	—	200
Growth Rate					
1980–1985	0.9%	4.1%	– 9.7%	—	2.1%

[a] ABS estimated 1983–1985.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney. Industry contacts.

DOMESTIC SALES & USE OF SELECTED THERMOPLASTICS BY PROCESS GRADE (Cont'd)

(millions of pounds)

MATERIAL/YEAR	TOTAL	INJECTION MOLDING	EXTRUSION	BLOW MOLDING	OTHER
Polystyrene					
1981	3,453	1,638	1,142	—	673
1982	3,105	1,368	1,060	—	677
1983	3,529	1,516	1,238	—	775
1984	3,735	1,436	1,468	—	831
1985	4,024	1,403	1,737	—	884
Growth Rate					
1980–1985	3.8%	−2.6%	9.9%	—	5.7%
Nylon					
1981	270	178	76	—	16
1982	229	138	71	—	20
1983	305	198	85	—	22
1984	363	243	95	—	25
1985	378	251	100	—	27
Growth Rate					
1980–1985	8.8%	8.2%	6.2%	—	40%
Thermoplastic Polyester[b]					
1981	539	150	7	380	2
1982	571	100	10	456	5
1983	697	163	15	514	5
1984	760	200	20	535	5
1985	842	190	25	622	5
Growth Rate					
1980–1985	11.8%	7.4%	43%	13.2%	60%
P V C					
1981	5,165	280	3,149	92	1,644
1982	4,890	261	3,129	103	1,397
1983	5,618	264	3,496	166	1,692
1984	6,420	277	4,330	186	1,627
1985	6,429	228	4,481	163	1,557
Growth Rate					
1980–1985	5.4%	−6.4%	8.5%	10.7%	0.1%

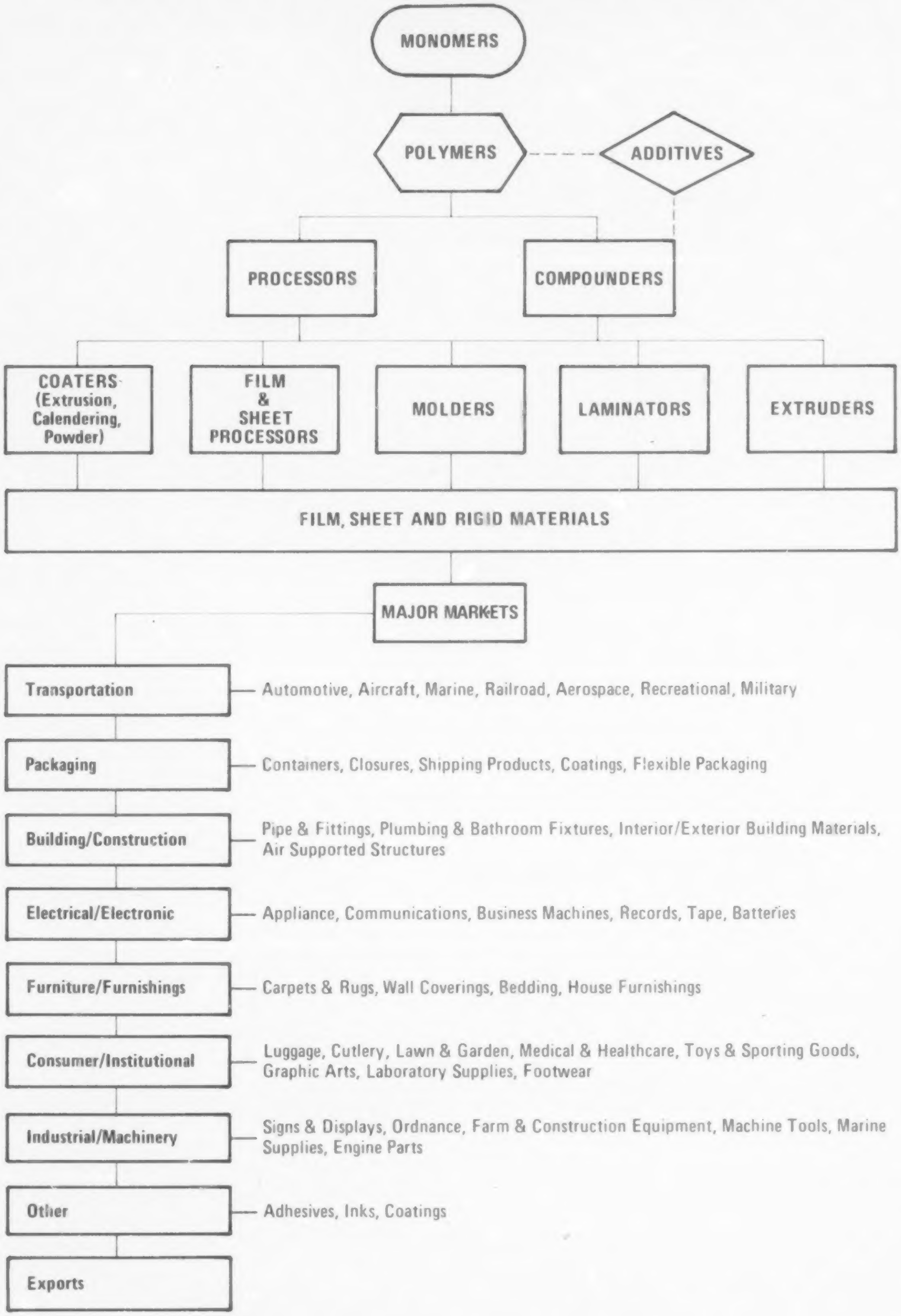
[b] Thermoplastic Polyester estimated 1983–1985.

n.a. = not available.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney. Industry contacts.

FABRICATED PLASTIC PRODUCTS

FLOW CHART: FROM RAW MATERIAL TO FINAL PRODUCT


MONOMERS
POLYMERS
ADDITIVES
PROCESSORS
COMPOUNDERS
COATERS (Extrusion, Calendering, Powder)
FILM & SHEET PROCESSORS
MOLDERS
LAMINATORS
EXTRUDERS
FILM, SHEET AND RIGID MATERIALS
MAJOR MARKETS
Transportation
Automotive, Aircraft, Marine, Railroad, Aerospace, Recreational, Military
Packaging
Containers, Closures, Shipping Products, Coatings, Flexible Packaging
Building/Construction
Pipe & Fittings, Plumbing & Bathroom Fixtures, Interior/Exterior Building Materials, Air Supported Structures
Electrical/Electronic
Appliance, Communications, Business Machines, Records, Tape, Batteries
Furniture/Furnishings
Carpets & Rugs, Wall Coverings, Bedding, House Furnishings
Consumer/Institutional
Luggage, Cutlery, Lawn & Garden, Medical & Healthcare, Toys & Sporting Goods, Graphic Arts, Laboratory Supplies, Footwear
Industrial/Machinery
Signs & Displays, Ordnance, Farm & Construction Equipment, Machine Tools, Marine Supplies, Engine Parts
Other
Adhesives, Inks, Coatings
Exports

Source: SPI, Committee on Resin Statistics, *Major Markets Manual.*

REINFORCED PLASTICS SHIPMENTS BY MARKET

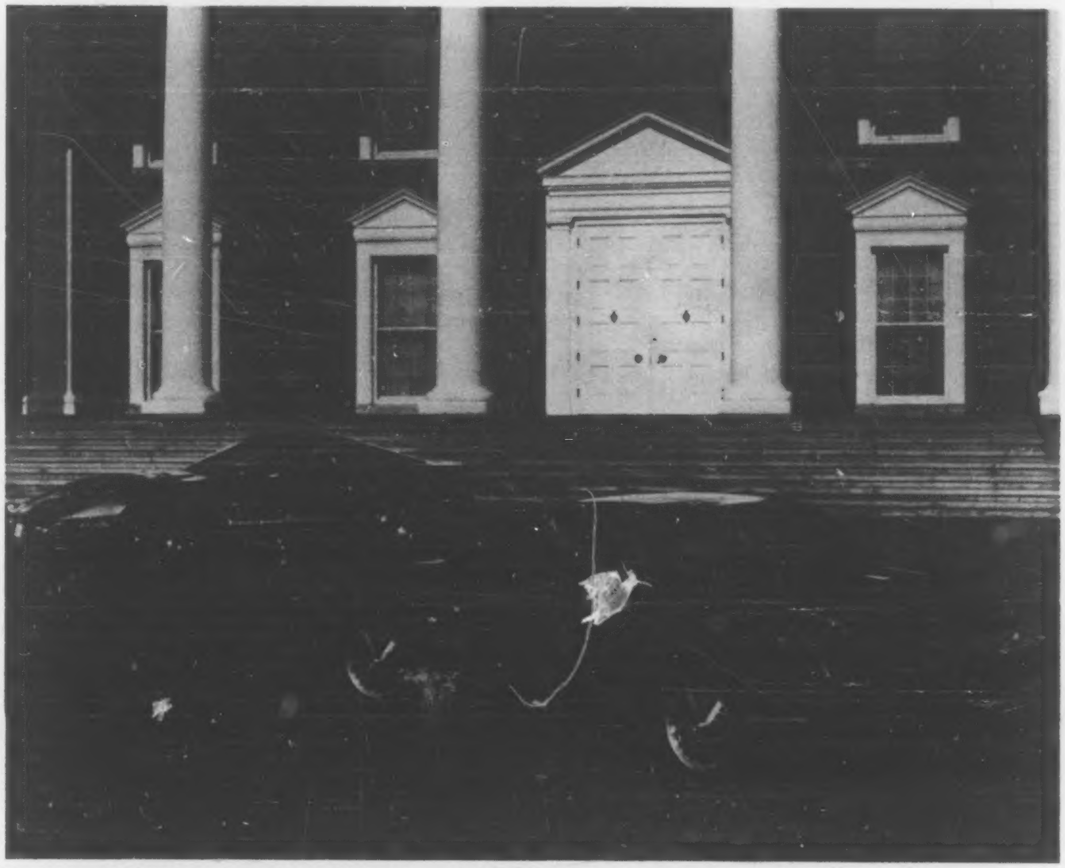
(BOTH THERMOSET & THERMOPLASTIC RESINS)

	SHIPMENTS (in millions of pounds)					
MARKETS	**1981**	**1982**	**1983**	**1984**	**1985[1]**	**1986[2]**
Aircraft & Aerospace	28	22	25	29	32	37
Appliances & Equipment	117	82	106	123	133	138
Construction	317	312	400	430	445	454
Consumer Goods	115	84	128	143	142	145
Corrosion-Resistant Products	275	235	288	310	295	302
Electrical Rods, Tubes, Parts	178	140	170	189	191	199
Marine & Marine Accessories	290	230	276	309	335	347
Land Transportation	445	359	458	540	563	579
Miscellaneous	75	64	72	80	82	85
Total	1,840	1,528	1,923	2,153	2,218	2,286

[1] = estimate

[2] = forecast

Source: Reinforced Plastics/Composites Institute, SPI.



The all-composite body Chevrolet Corvette (rear) uses SMC (Glass fiber reinforced polyester Sheet Molding Compound) panels adhesive bonded into a single high performance unit. Rocker panels and fascia panels, front and rear, are flexible RRIM (Glass fiber reinforced Reaction Injection Molded Polyurethane).

The same materials—rigid SMC and flexible RRIM—are used by Pontiac to build Fiero, the first high volume production sports car. Flexible RRIM panels provide extra damage resistance in fenders, doors, and rear quarter panels. Damage repair is made easy by quick replacement of the bolt-on panels.

HIGH DENSITY POLYETHYLENE—SELECTED END-USES
(in millions of pounds)

	1981	1982	1983	1984
FILM	281	281	370	361
Millinary/Merchandising Bags	97	121	165	168
Food Packaging	52	64	101	76
All Other	132	96	104	117
INJECTION MOLDING	958	1,071	1,175	1,129
Industrial and Shipping Pails[1]	193	259	232	324
Housewares[2]	118	123	175	105
Crates and Totes[3]	92	108	146	112
Toys	76	74	111	63
Aerosol Overcaps, caps, closures	51	66	70	91
Food Tubs or Containers	204	172	174	238
All Other	224	269	267	196
BLOW MOLDING	1,640	1,603	1,733	2,027
Liquid Food Bottles	622	679	698	687
Household Chemicals	569	560	600	657
Industrial Drums	113	69	90	163
Pharmaceuticals, Cosmetics & Toiletries	135	106	127	113
All Other	201	189	218	407
ROTOMOLDING	40	n.a.	64	n.a.
PIPE AND CONDUIT	405	390	465	469
Corrugated	121	165	195	138
Gas Distribution	107	79	74	126
All Other	177	146	196	205

n.a. = not available

[1] 5 gallons or less
[2] Includes household pails
[3] Includes beverage cases

Source: SPI, Committee on Resin Statistics as compiled by Ernst & Whinney.

LOW DENSITY POLYETHYLENE—SELECTED END USES
(in millions of pounds)

	1981	1982	1983	1984
PACKAGING FILM	2,528	2,669	3,155	2,955
Food Packaging	891	933	1,092	874
Produce	207	192	146	74
Bakery	239	292	256	243
All Other	445	449	690	557
Non-Food Packaging	1,341	1,446	1,692	1,705
Industrial Liners	836	819	966	949
Shipping Sacks	82	138	141	219
All Other	423	489	585	537
Pallet Shrink Film	131	121	107	72
All Other Shrink Film	57	55	81	69
Stretch Film	108	114	183	235
Non-Packaging Film	1,497	1,518	1,455	1,640
Trash Bags	1,004	993	881	902
Construction and Agriculture	166	190	164	194
All Other	327	335	410	544
INJECTION MOLDING	514	471	578	555
Lids	142	130	160	140
Toys and Novelties	31	25	31	23
Housewares	195	142	221	223
All Other	146	174	166	169
EXTRUSION COATING	565	529	559	637
Paperboard	308	292	338	384
All Other	257	237	221	253
ROTOMOLDING RESINS	40	n.a.	23	56

n.a. = not available
Source: SPI, Committee on Resin Statistics as compiled by Ernst & Whinney.

PLASTIC BOTTLES: PRODUCTION

(in millions of units)

BY TYPE	1980	1981	1982	1983	1984	Growth Rate 1979–1984
Household Chem.	2,874	2,843	2,855	2,899	2,943	0.6%
Industrial Chem. & Spec.	315	308	348	387	400	–0.8%
Toiletries & Cosmetics	2,176	2,238	2,201	2,405	2,335	2.8%
Medicinal & Health	2,247	2,371	2,257	2,335	2,787	5.7%
Food & Beverages	5,820	6,246	6,868	7,310	7,300	9.7%
Automotive & Marine	265	211	319	334	673	17.6%
Not Specified by Kind	578	526	651	777	990	14.3%
Total	14,275	14,743	15,499	16,447	17,428	6.3%

Source: U.S. Dept. of Commerce, Bureau of the Census

EXPLANATION OF TERMS

Household Chemicals— Bleach, dishwashing, laundry, and other detergents; fabric softeners; blow and drain cleaners; dry cleansers; floor care products; soaps (including medicated); window cleaners; air fresheners; household pesticides and garden chemicals; household adhesives; waxes and polishes (including car polish); car wax, wax and polish remover, etc.

Industrial, Agricultural and Specialty Chemicals— Agricultural, industrial, and institutional chemical and cleaning products; photographic chemicals; battery acid; paint and varnish supplies, etc.

Toiletries and Cosmetics— Shampoos and other hair grooming products; talcs and powders; hand, face, and body lotions and ointments; shaving preparations; bath products; perfumes, toilet water, and colognes; personal deodorant, etc.

Medicinal and Health— Oral antiseptics and mouthwashes; laxatives; pharmaceutical lotions, creams, and ointments; pain relievers; vitamins; rubbing alcohols; antacids, etc.

Food and Beverages— Milk; carbonated beverages; noncarbonated beverages such as juices, water, cider, etc.; distilled spirits and other alcoholic beverages; edible oil; and all other food items.

Automotive and Marine— Antifreeze; motor oil; lubricants; defrosters; windshield cleaners; hydraulic fluids; additives, etc.

BY MATERIAL (in millions of pounds)	1980	1981	1982	1983[r]	1984	Growth Rate 1979–1984
HD Polyethylene	1,077	1,146	1,236	1,162	1,255	2.3%
LD & MD Polyethylene	77	51	47	67	82	6.0%
Polyvinyl Chloride	98	94	93	100	129	9.7%
Polypropylene	44	52	52	64	68	13.0%
Polyethylene Terephthalate	*	404	411	227	209	n.c.
Other Resins	348	7	6	29	34	n.c.
Total	1,644	1,754	1,845	1,649	1,777	3.7%

n.c. = not comparable

*Included in other resins.

[r] = revised from 1985 edition

PLUMBING FIXTURES: SHIPMENTS

(Thousands of units)

LAVATORIES

	Total	Vitreous China	Cast Iron	Steel	Plastics[1]
1981	4,062	2,262	534	814	452
1982	3,562	1,887	506	854	315
1983	5,100	2,514	519	1,470	597
1984	7,252	2,572	632	1,768	2,280
1985	7,598	2,770	602	1,860	2,366

BATHTUBS

	Total	Cast Iron	Steel	Plastics
1981	2,291	560	793	938
1982	2,399	545	809	1,045
1983	3,418	551	1,292	1,575
1984	3,943	595	1,280	2,068
1985	4,273	585	1,407	2,281

SHOWER STALLS, INC. RECEPTORS

	Total	Metals	Plastics
1981	321	22	299
1982	312	9	303
1983	424	12	412
1984	605	10	595
1985	707	39	668

[1] Includes concrete and other nonmetals.

Source: U.S. Dept. of Commerce, Bureau of the Census.

PRODUCER PRICE INDEXES—PLASTICS PRODUCTS

Plastics Product	Index Base	Dec. 1985 Index	12 Month % Change
Appliances	12/82	105.8	11.1
Bags, Polyethylene	12/83	102.0	−0.5
Bottles	12/82	101.9	−1.7
Business Machines	12/82	112.1	0.5
Caps and Closures	12/82	105.8	2.3
Cups, Nonfoam	1/83	104.6	0.4
Dinnerware, Tableware & Kitchenware	12/82	104.2	−1.6
Doors, Partitions, Moldings, Windows & Frames, and Decorative Trim	12/82	106.1	1.4
Fixture Tops, Laminated	12/83	117.7	4.5
Flower Pots & Plant Containers	12/82	97.4	−1.2
Foamed Products	12/82	95.8	0.4
Food Trays	12/82	101.8	0.1
Footwear, Men's Upper	12/80	103.7	−0.6
Footwear, Women's Upper	12/80	105.6	2.8
Furniture	12/82	98.5	−5.8
Gears, Bearings, Bushings, & Cams	12/82	104.7	2.0
Handbags & Purses	6/82	113.7	0.9
Hose	12/81	121.9	6.2
Hospitalware	12/82	121.2	8.6
Kitchen Cabinets, Custom, Laminated	6/84	103.8	1.7
Kitchen Cabinets, Stock, Laminated	6/84	100.2	−2.6
Lenses, ophthalmic focus	12/83	96.0	−4.2
Machinery, Blow Molding	4/82	108.3	0.6
Machinery, Extrusion	12/81	117.2	0.6
Machinery, Injection Molding	12/81	119.3	2.5
Molds for Plastics	6/81	110.0	0.5
Motorboats, Inboard, Cabin Cruisers	12/81	116.2	4.5
Motorboats, Outboard, Runabouts	12/81	116.7	3.5
Motor Vehicle Parts	12/82	105.5	1.6
Panels, Corrugated & Flat	12/82	105.6	2.5
Piping	12/82	96.7	−5.0
Plumbing Fixtures	12/82	100.3	0.5
Shower/Bath Curtains	6/83	79.1	−7.1
Window Shades	6/84	93.5	−6.5

n.a. = not available
Source: U.S. Dept. of Labor, Bureau of Labor Statistics

MAJOR MARKETS

DEFINITIONS

The primary product groups for each Major Market category are listed below:

A. TRANSPORTATION

Motor Vehicles and Parts: including autos, trucks, buses, motorcycles, and bicycles.

All Other: including railroad equipment, travel trailers, campers, golf carts, snowmobiles, aircraft, military vehicles, ships, boats, and recreational vehicles.

B. PACKAGING

Bottles, Jars, Vials

Food Containers: excluding disposable cups

Flexible Packaging: including household and institutional refuse bags and film

All Other: including tubes, tape, strapping, drums, caps, baskets, trays, boxes, pallets, shipping crates, pails, buckets, shipping cases, blister and bubble containers.

C. BUILDING AND CONSTRUCTION

Pipe, Conduit and Fittings: including drainage, irrigation, plumbing fixtures, septic tanks

Building Material for all Structures: including siding, flooring, and insulation materials

All Other: including panels, doors, windows, skylights, bathroom units, gratings and railings.

D. ELECTRICAL AND ELECTRONIC

Home and Industrial Appliances: including electrical industrial equipment, wire and cable coverings, communications equipment

Electronic Components: including resistors, magnetic tape, records, and batteries.

E. FURNITURE AND FURNISHINGS

Rigid and Flexible Types: including household and office furniture, bedding, carpets, rugs, backing, curtains, blinds, awnings, lamps, picture frames, wall coverings.

F. CONSUMER AND INSTITUTIONAL PRODUCTS

Disposable Food Serviceware, including disposable cups

Dinner and Kitchenware: including picnicware

Toys and Sporting Goods

Health Care and Medical Products: including laboratory supplies

Hobby and Graphic Arts Supplies: including photographic equipment and supplies

All Other: including footwear, luggage, buttons, lawn & garden tools, signs and displays, credit cards.

G. INDUSTRIAL/MACHINERY

All Types: including engine and turbine parts, farm and garden machinery, construction and related equipment, machine tools, ordnance and firearms, chemical process equipment.

H. ADHESIVES/INKS/COATINGS

Adhesives and Sealants

All Other: including printing ink, magnet wire enamels, core binders, foundry facings, paper coating and glazing, paints, varnishes, and enamels.

I. RESELLERS/COMPOUNDERS

Sales of Resins Sold to Resellers, Compounders, Converters

Unclassified Sales: including calenderers whose end-use markets cannot be ascertained by the resin supplies, or resin that cannot be classified under any of the Major Market categories listed above.

J. EXPORTS

Sales of Plastic Resin exported from the U.S.

1985 RESULTS

The 1985 data reflect major market plastics resins sales and captive use data compiled by Ernst & Whinney with consumption data being reported by individual resin. The plastics resins categories included in this study are:

THERMOSETS

- Epoxy
- Polyester, Unsaturated
- Urea and Melamine
- Phenolic
- All Other Thermosets

THERMOPLASTICS

- Low Density Polyethylene
- High Density Polyethylene
- Polypropylene
- Acrylonitrile-Butadiene-Styrene (ABS) and Styrene-Acrylonitrile (SAN)
- Styrene Butadiene Latexes (SBL), and Other Styrene Based Latexes OSBL), and Other Styrene Based Polymers (OSBP)
- Nylon
- Polyvinyl Chloride
- Thermoplastic Polyester
- All Other Thermoplastics

RESIN SALES & USE BY MAJOR MARKET*

(millions of pounds, dry weight basis)

MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	1,573	1,392	1,896	2,109	1,989
Packaging	10,465	10,497	11,813	12,398	12,774
Building/Construction	7,259	7,154	8,552	9,691	10,038
Electrical/Electronic	2,670	2,275	2,514	2,757	2,659
Furniture/Furnishings	1,670	1,556	2,007	2,117	2,107
Consumer & Institutional	3,670	3,269	3,816	3,986	3,975
Industrial/Machinery	393	241	318	400	364
Adhesives, Inks & Coatings	2,572	1,584	1,800	1,993	2,142
All Other	3,259	3,232	3,636	4,080	5,122
Exports	3,425	3,909	4,150	3,796	4,170
Total	36,956	35,109	40,502	43,327	45,340

*Note: All figures exclude polyurethane.

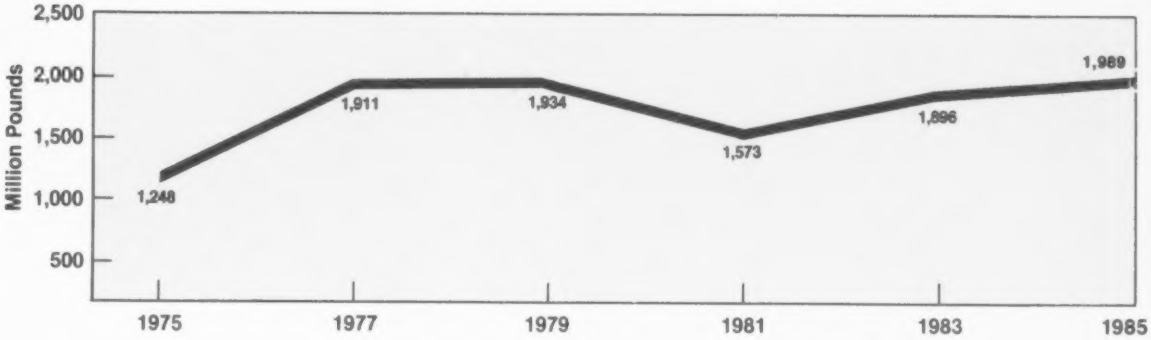
COMPARATIVE PERCENTAGE DISTRIBUTION BY MAJOR MARKET

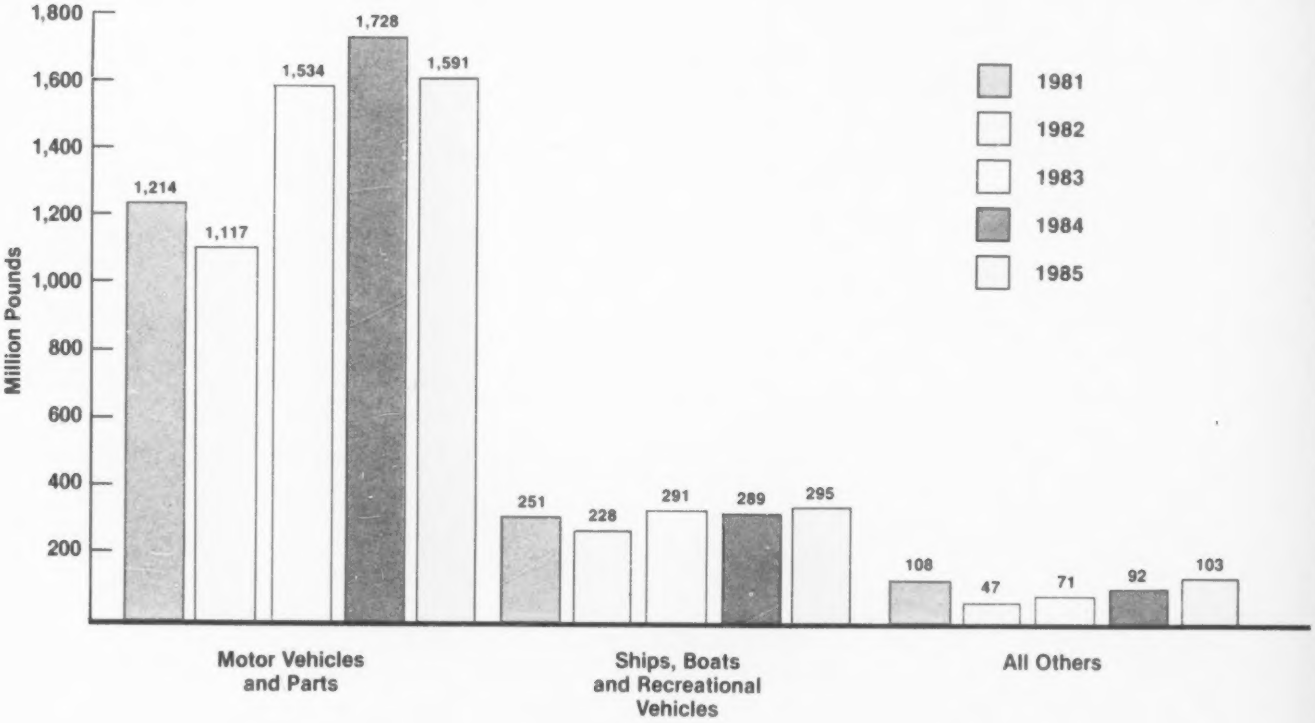
MAJOR MARKET	1981	1982	1983	1984	1985
Transportation	4.3%	4.0%	4.7%	4.9%	4.4%
Packaging	28.3	29.9	29.2	28.6	28.2
Building/Construction	19.6	20.4	21.1	22.4	22.1
Electrical/Electronic	7.2	6.5	6.2	6.4	5.9
Furniture/Furnishings	4.5	4.4	5.0	4.9	4.7
Consumer & Institutional	9.9	9.3	9.4	9.2	8.8
Industrial/Machinery	1.1	0.7	0.8	0.8	0.8
Adhesives, Inks & Coatings	7.0	4.5	4.4	4.6	4.7
All Other	8.8	9.2	9.0	9.4	11.2
Exports	9.3	11.1	10.2	8.8	9.2
Total	100.0%	100.0%	100.0%	100.0%	100.0%

PERCENTAGE CHANGE IN SALES AND USE BY MAJOR MARKET

MAJOR MARKET	% CHANGE 1985/1984	% CHANGE 1984/1983	GROWTH RATE 1980–1985
Transportation	−5.7%	11.2%	4.4%
Packaging	3.0	5.0	5.0
Building/Construction	3.6	13.3	9.3
Electrical/Electronic	−3.6	9.7	1.5
Furniture/Furnishings	−0.5	5.5	5.0
Consumer/Institutional	−0.3	4.5	2.3
Industrial/Machinery	−9.0	25.8	−1.4
Adhesives/Inks/Coatings	7.5	10.7	−2.1
All Other	25.5	12.2	10.9
Exports	9.9	−8.5	2.7
Total	4.7%	7.0%	5.2%

TRANSPORTATION





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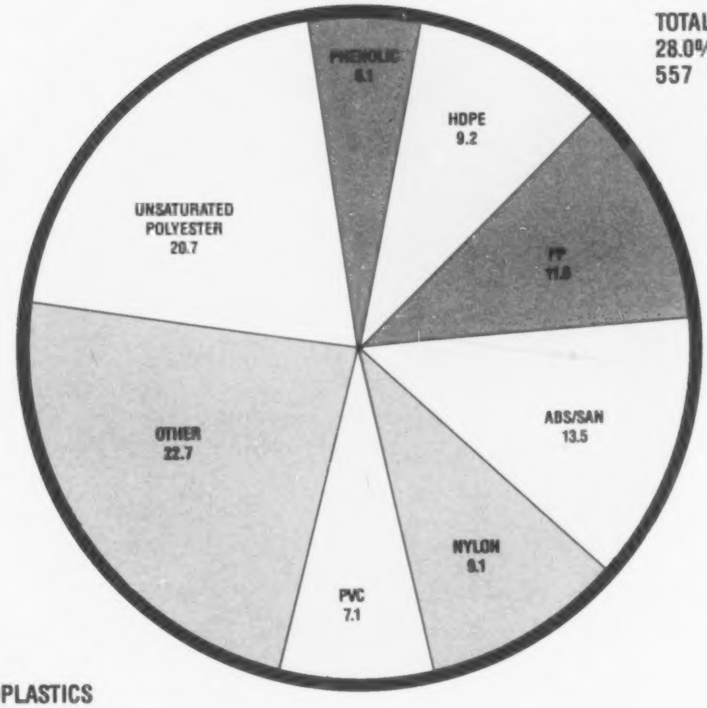
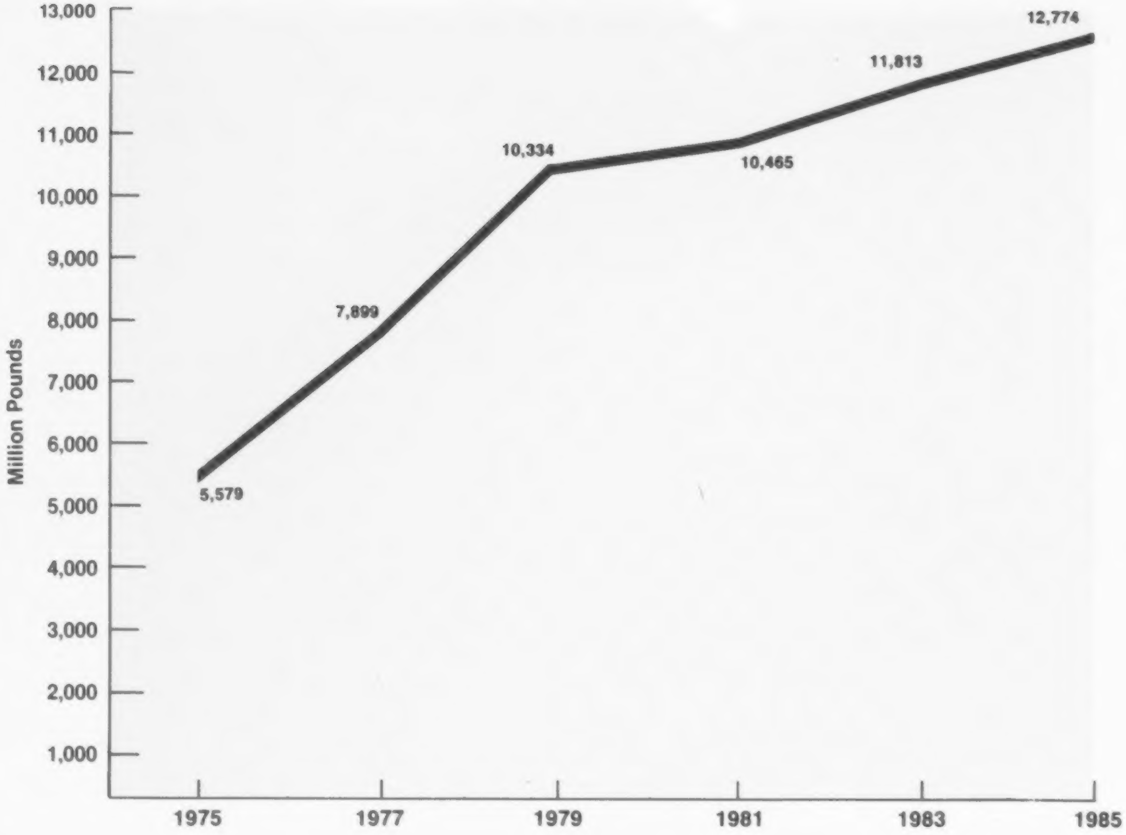
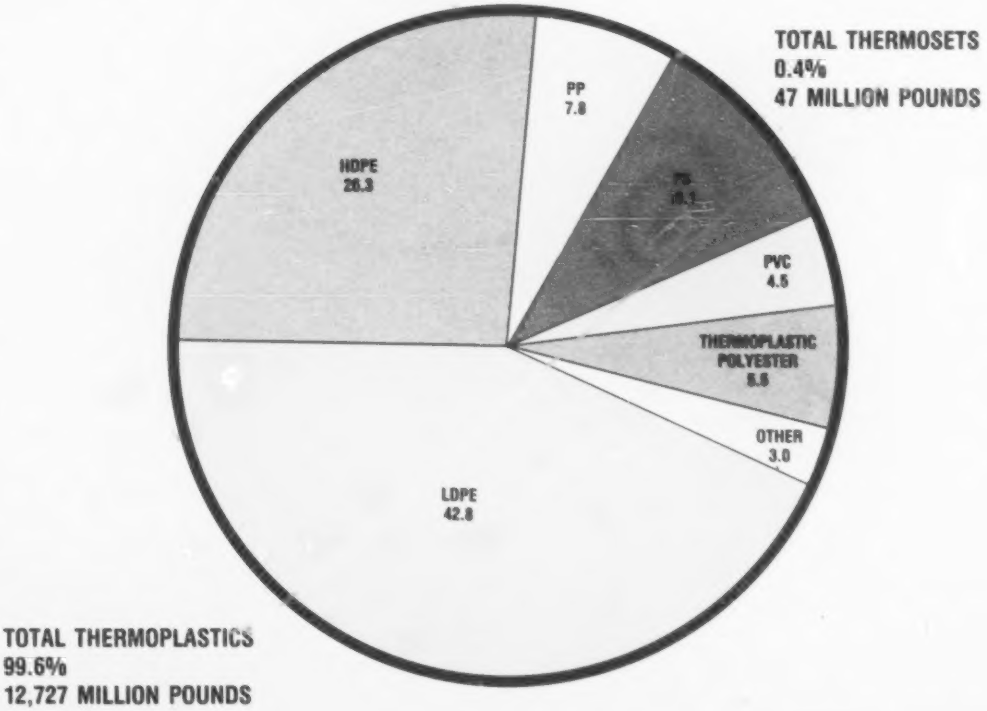


PACKAGING

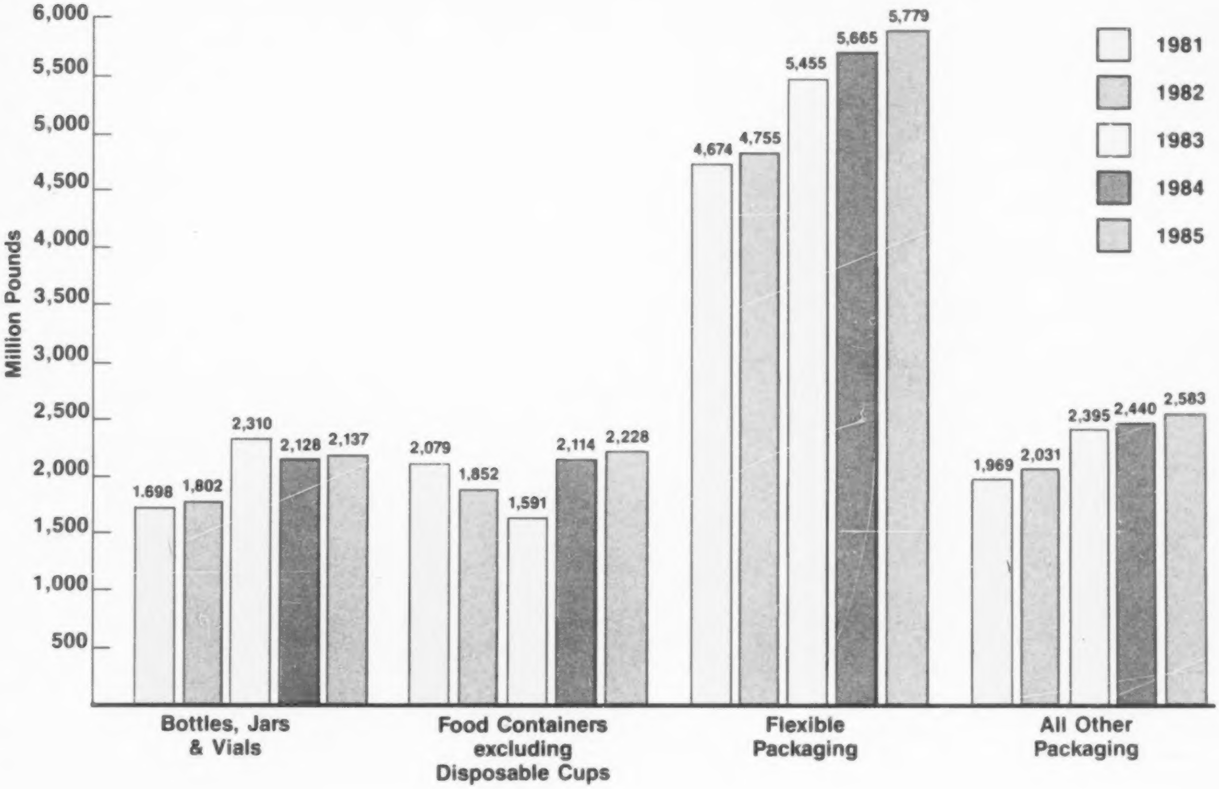


Million Pounds
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
1975
1977
1979
1981
1983
1985
5,579
7,899
10,334
10,465
11,813
12,774

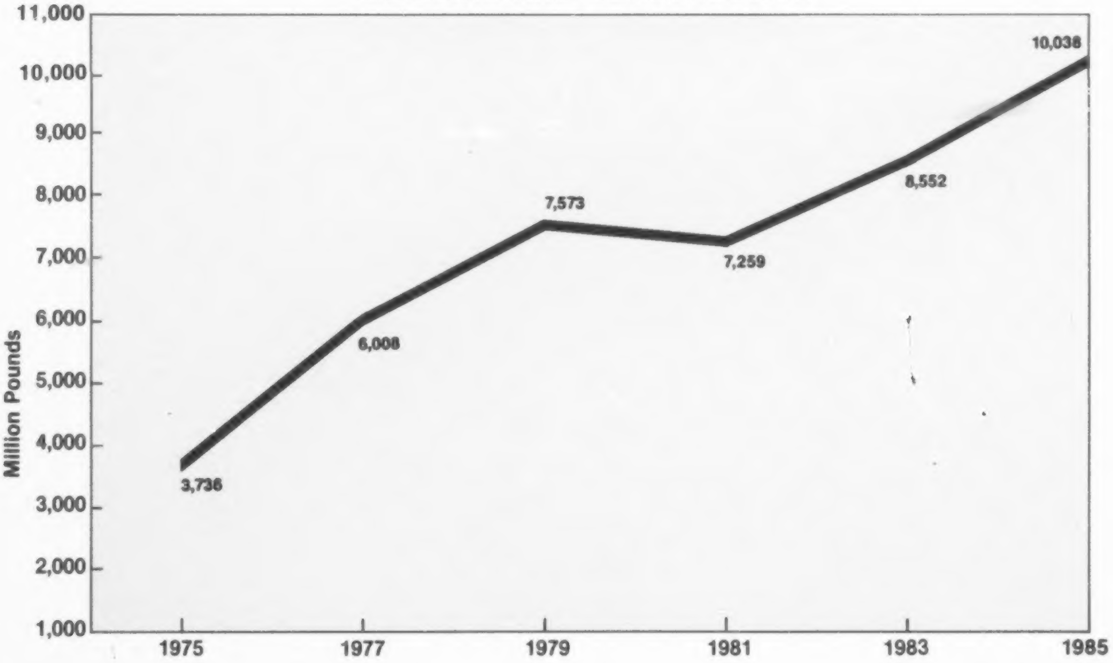


TOTAL THERMOSETS
0.4%
47 MILLION POUNDS
PP
7.8
PS
10.1
PVC
4.5
THERMOPLASTIC
POLYESTER
5.6
OTHER
3.0
LDPE
42.8
HDPE
26.3
TOTAL THERMOPLASTICS
99.6%
12,727 MILLION POUNDS

PACKAGING — THERMOPLASTIC DISTRIBUTION



BUILDING AND CONSTRUCTION



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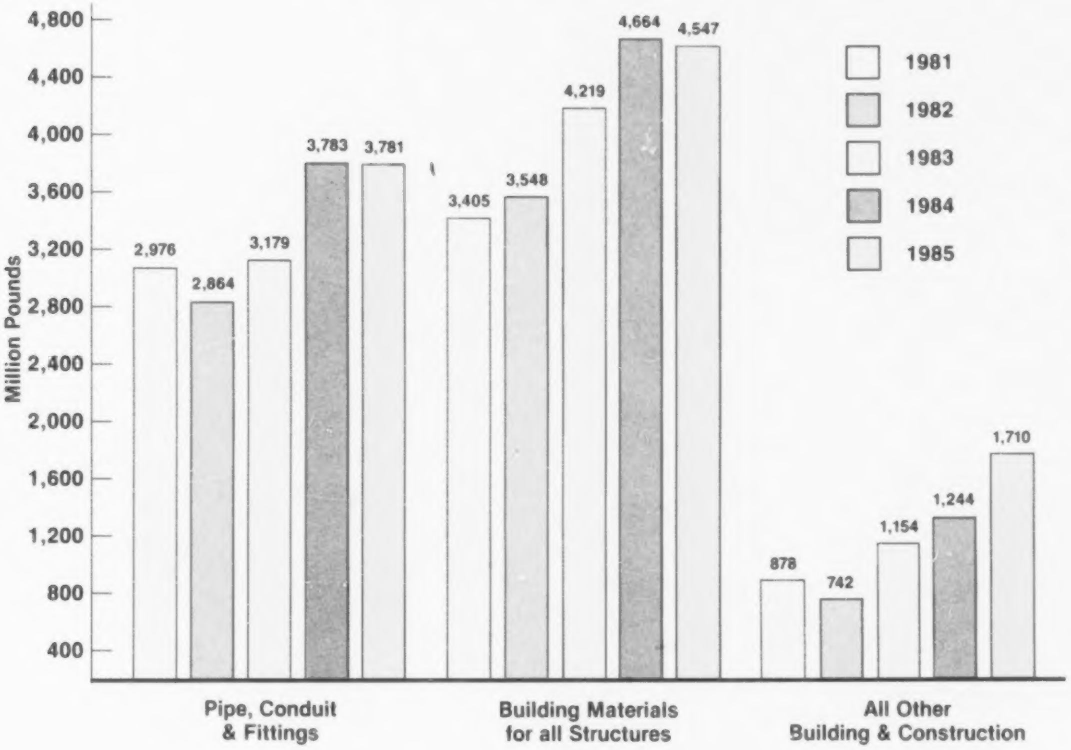
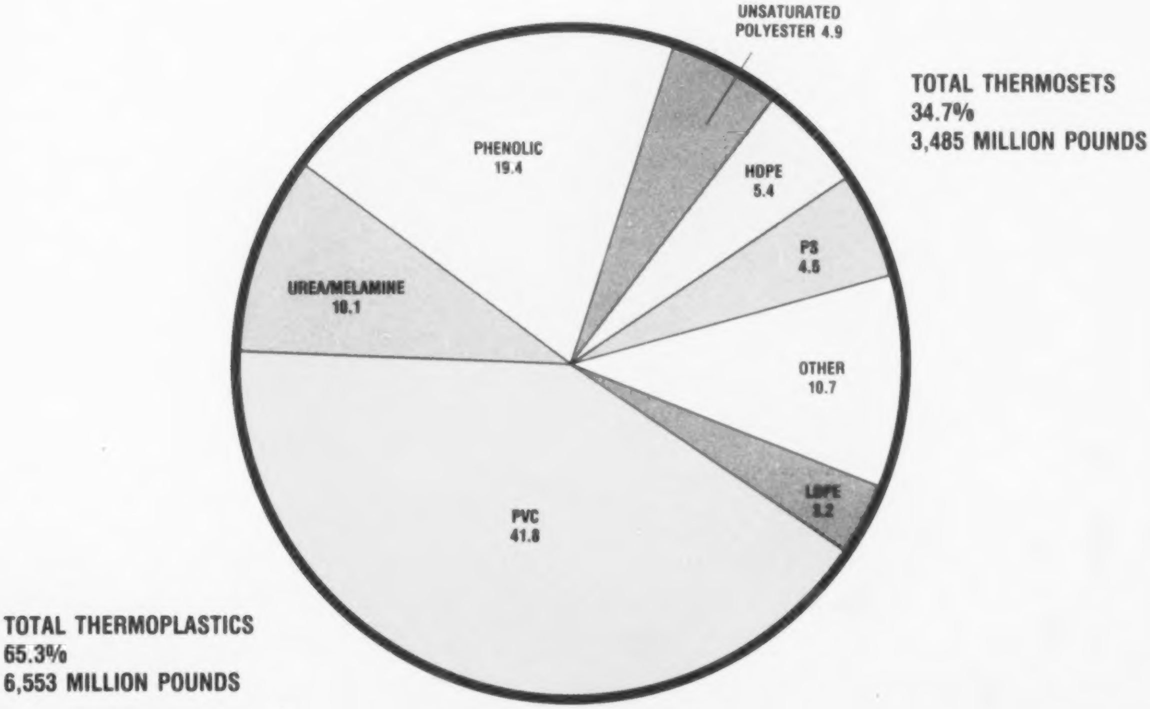
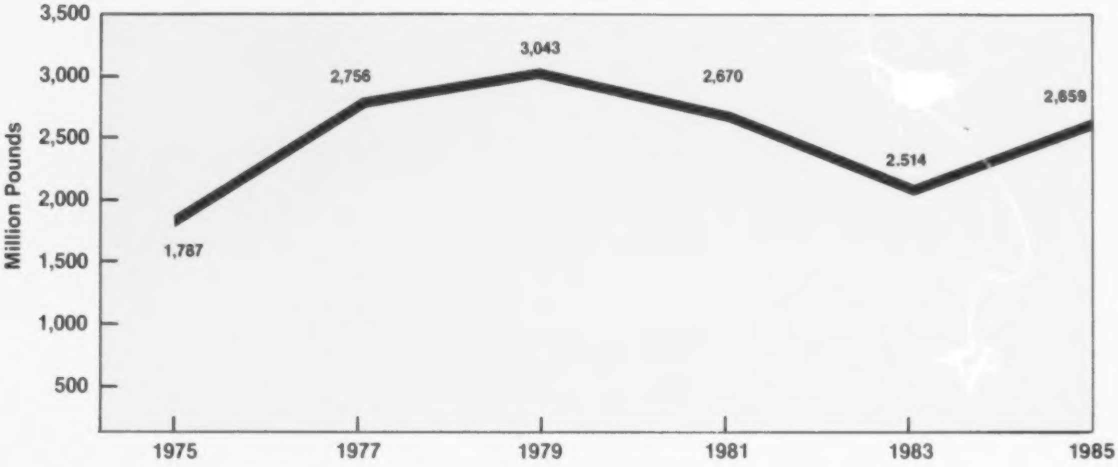
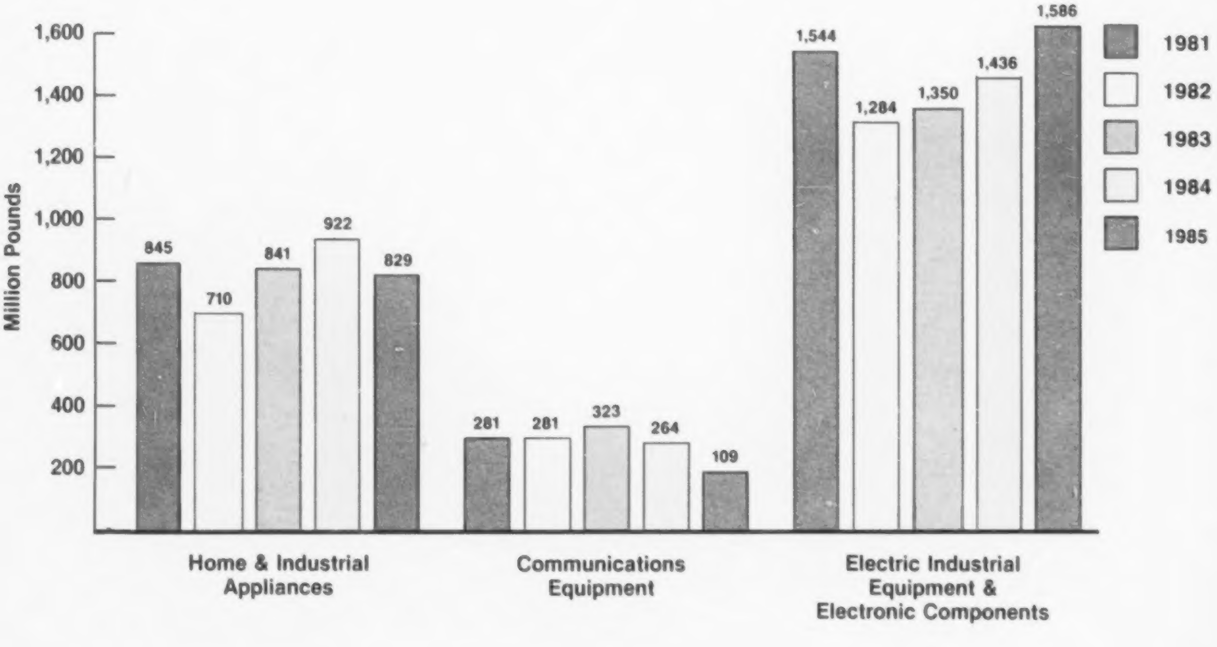


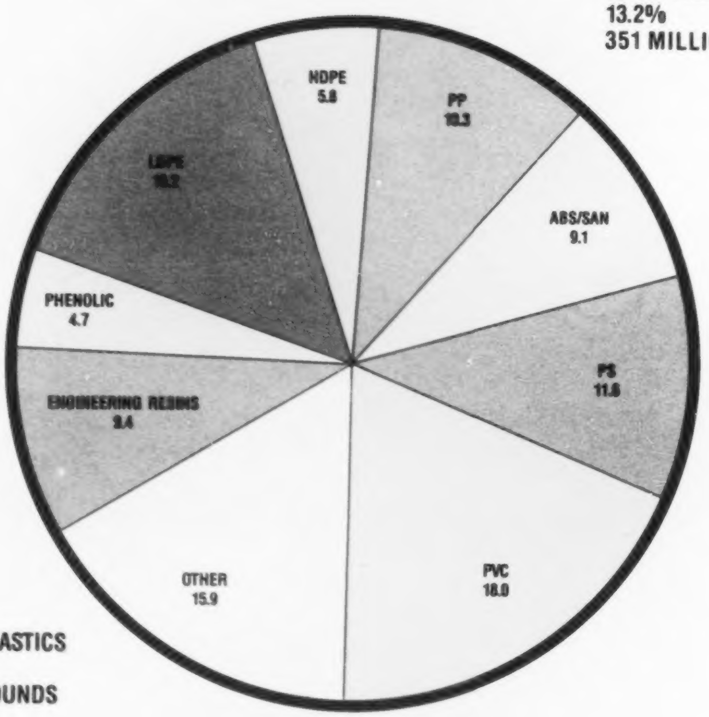


ELECTRICAL AND ELECTRONIC





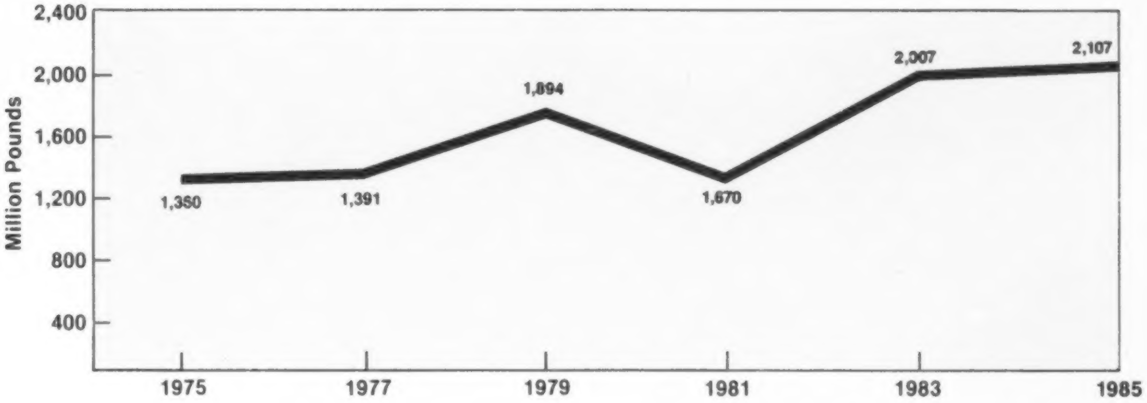
ELECTRICAL AND ELECTRONIC (cont'd.)

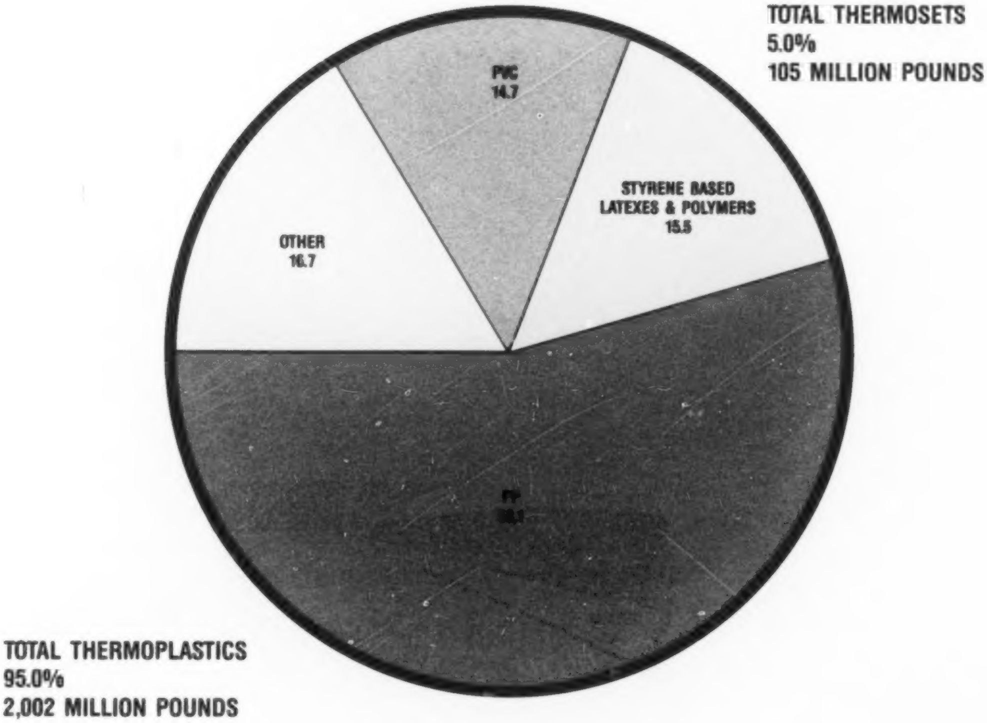


TOTAL THERMOSETS
13.2%
351 MILLION POUNDS

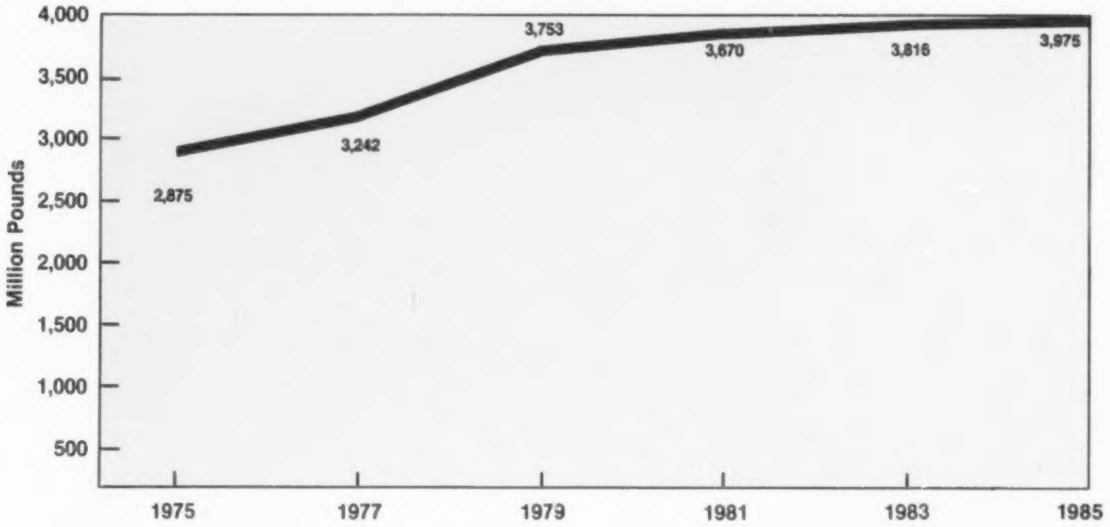
TOTAL THERMOPLASTICS
86.8%
2,308 MILLION POUNDS

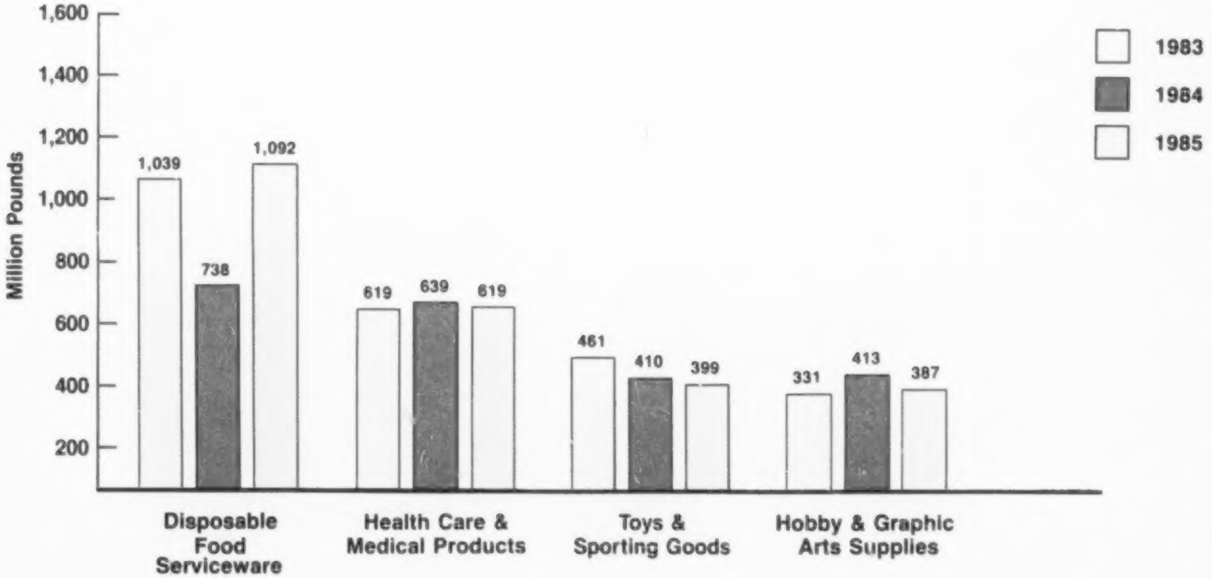
FURNITURE AND FURNISHINGS



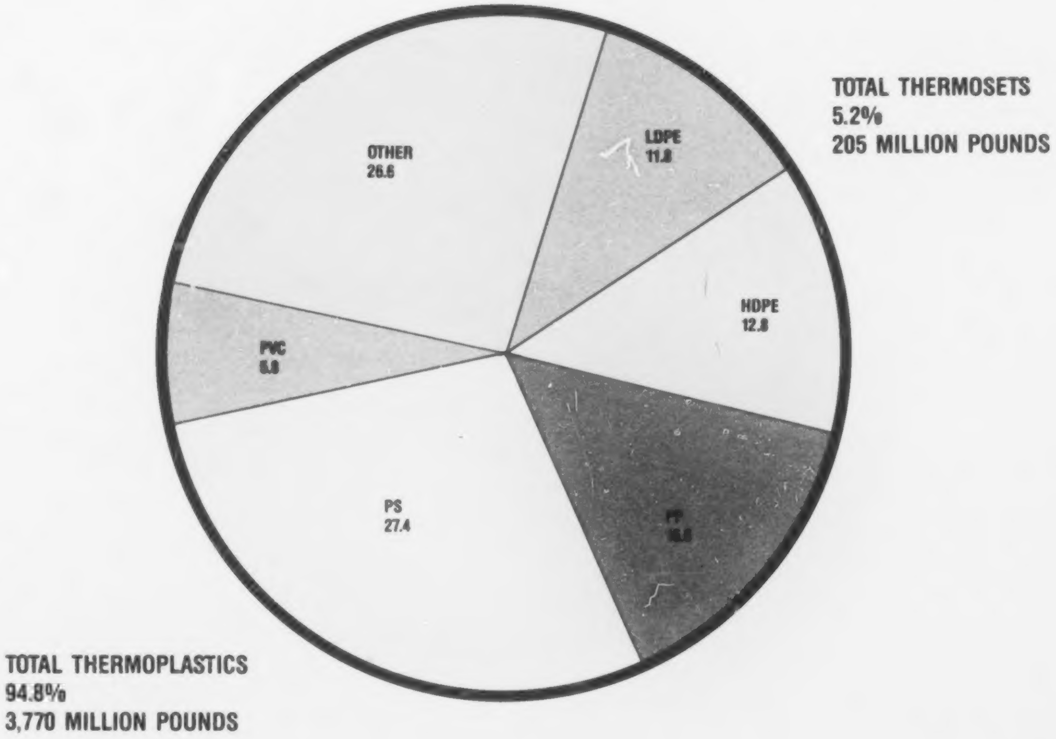


CONSUMER AND INSTITUTIONAL

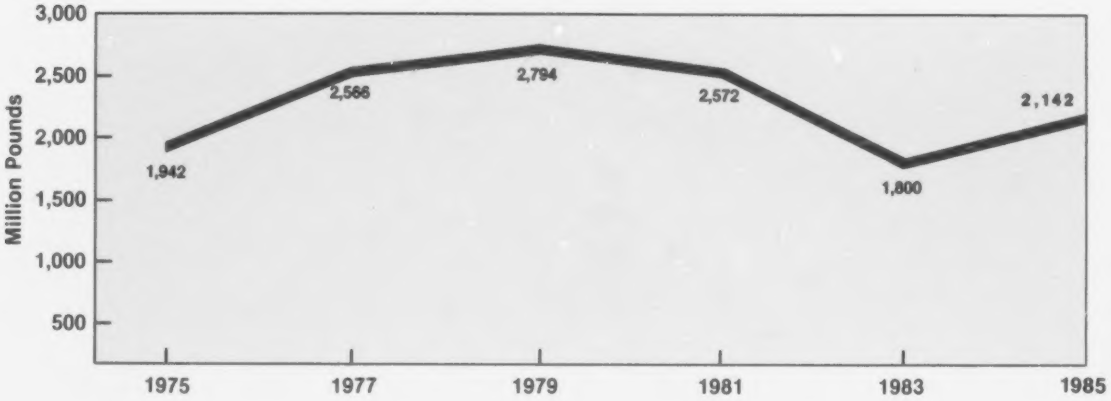


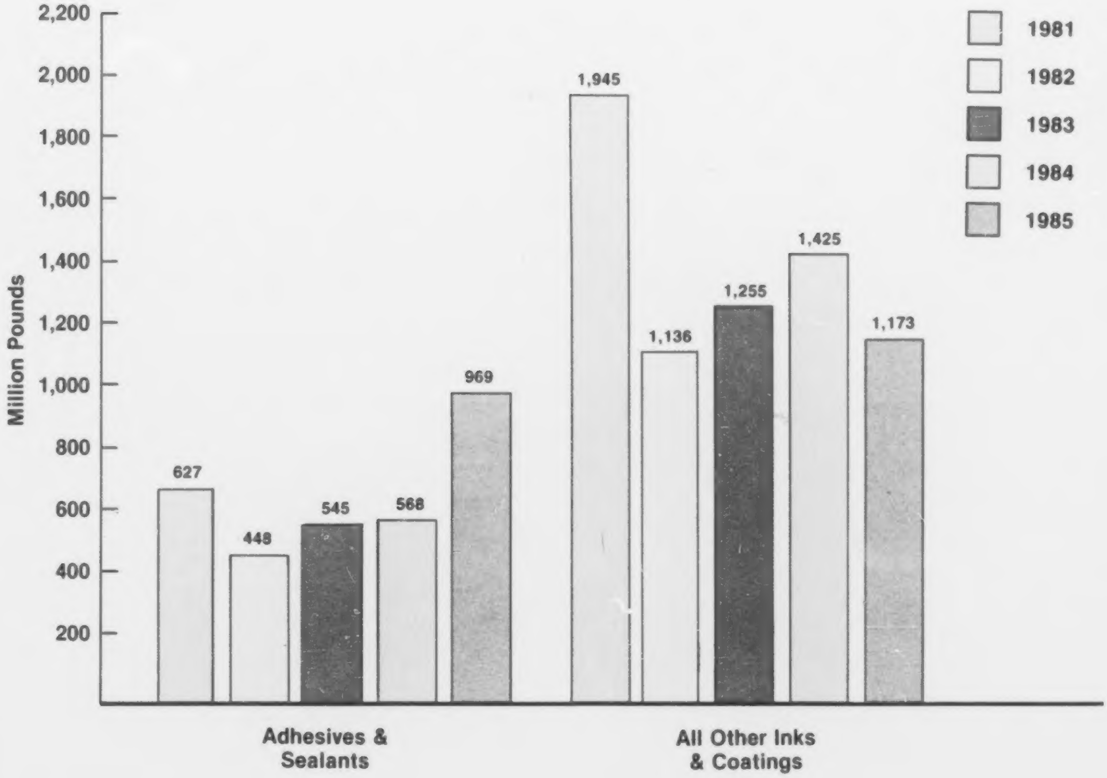


CONSUMER AND INSTITUTIONAL (cont'd.)



ADHESIVES/INKS/COATINGS





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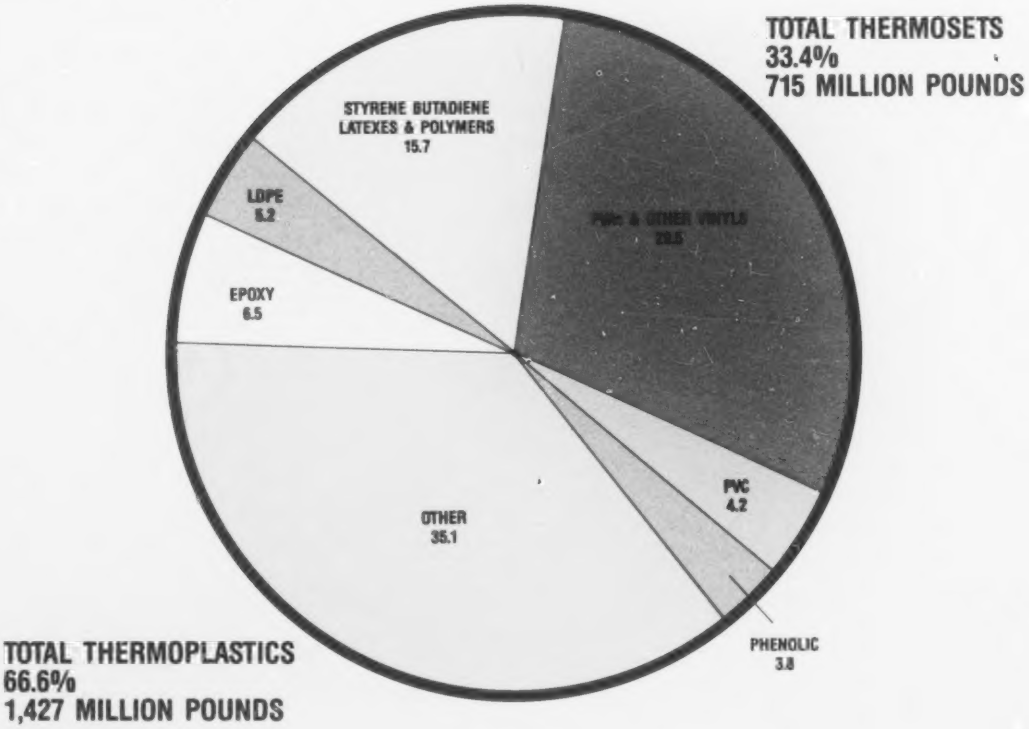
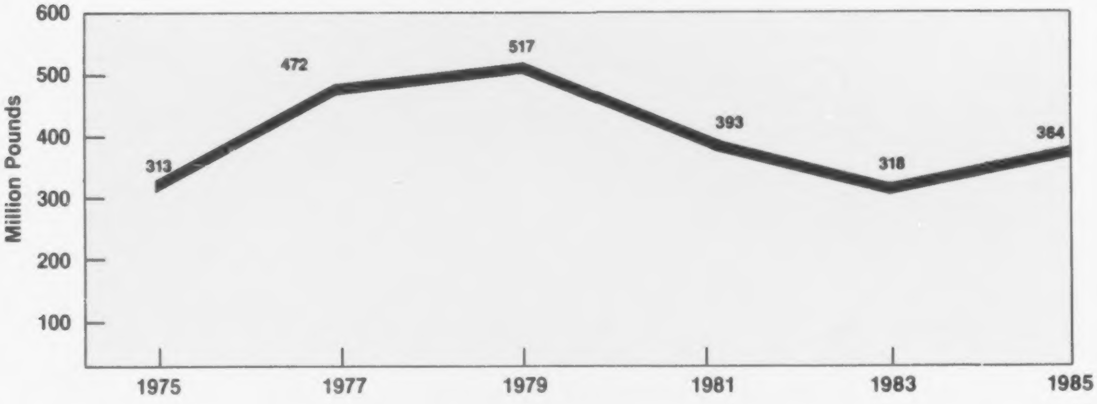
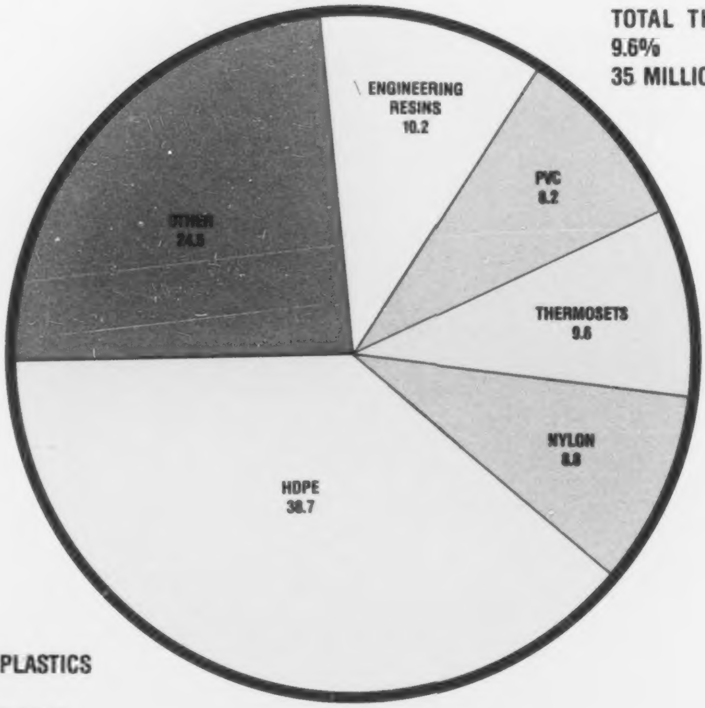


INDUSTRIAL/MACHINERY

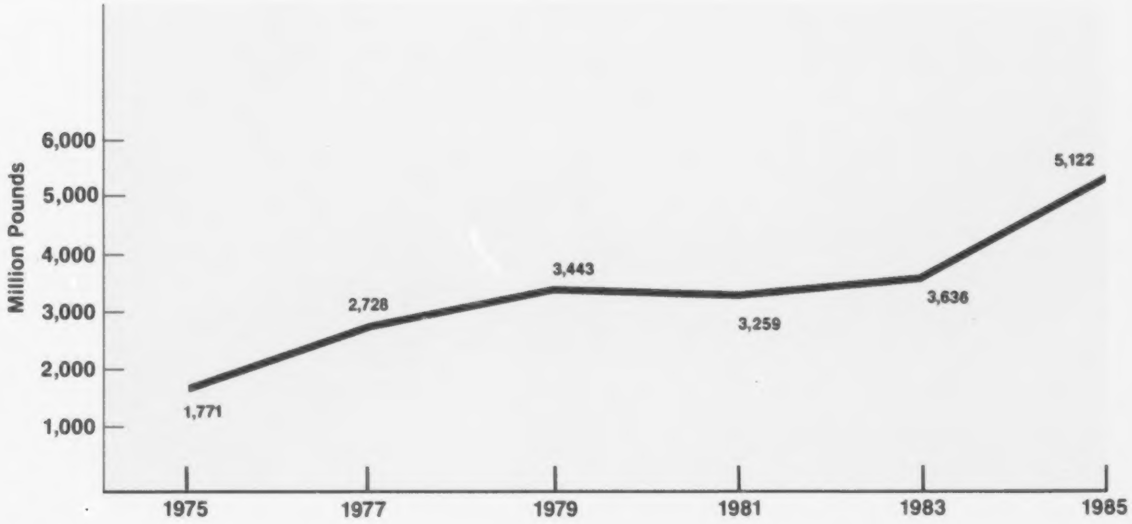


TOTAL THERMOSETS
9.6%
35 MILLION POUNDS

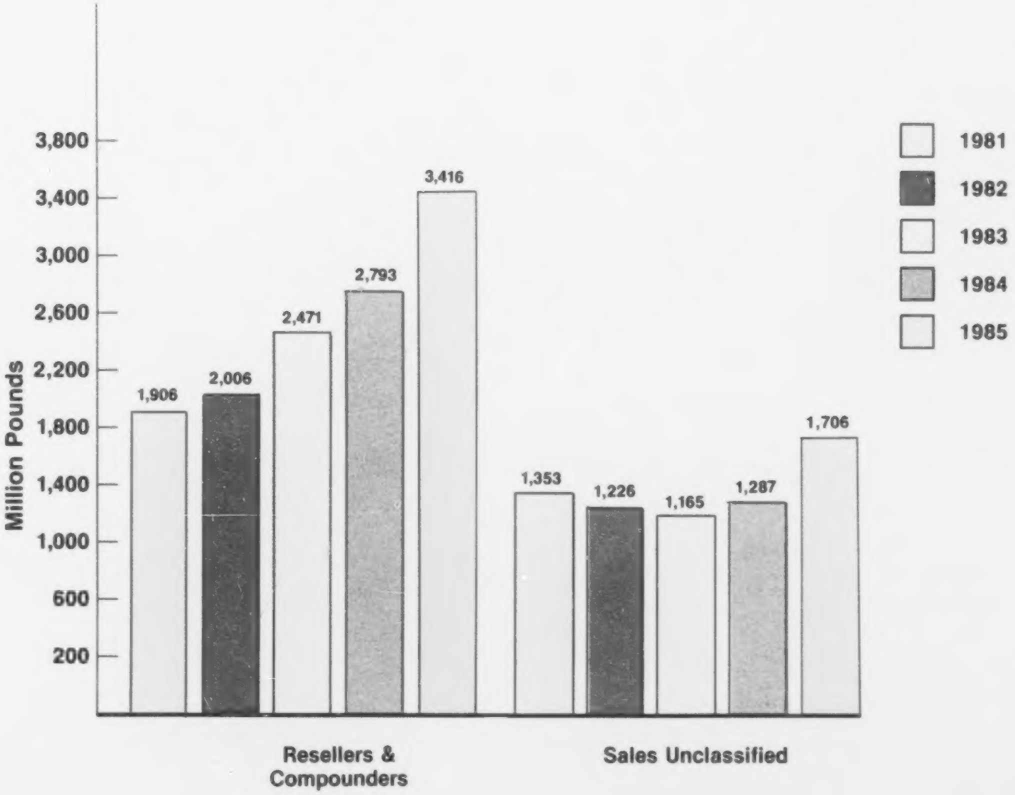


TOTAL THERMOPLASTICS
90.4%
329 MILLION POUNDS

ALL OTHER

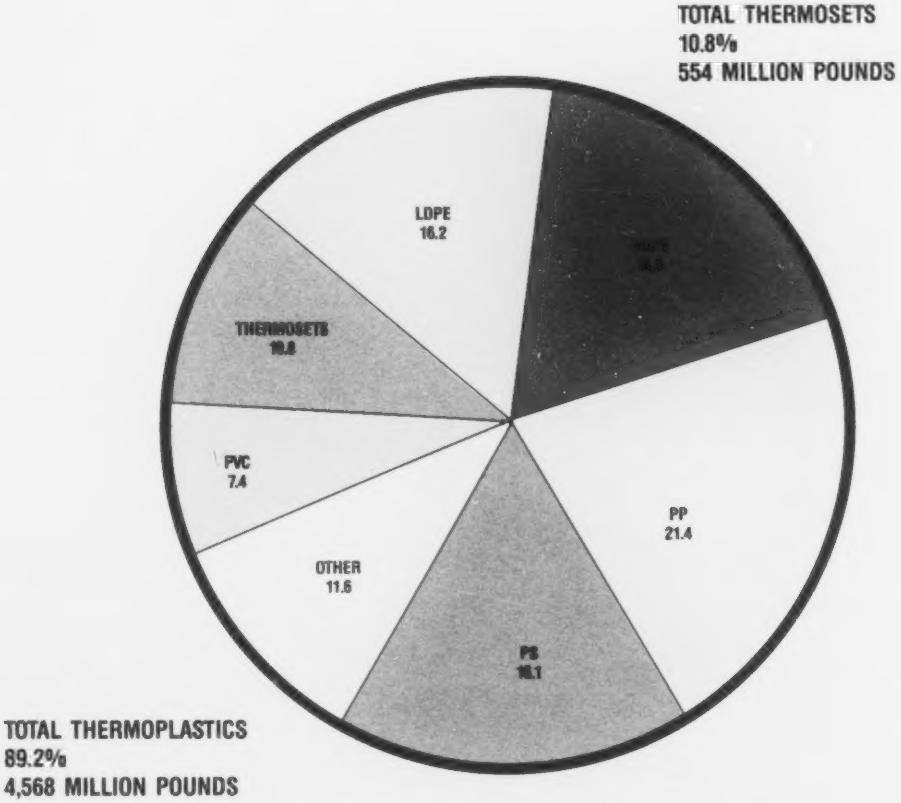


Million Pounds
6,000
5,000
4,000
3,000
2,000
1,000
1,771
2,728
3,443
3,259
3,636
5,122
1975
1977
1979
1981
1983
1985

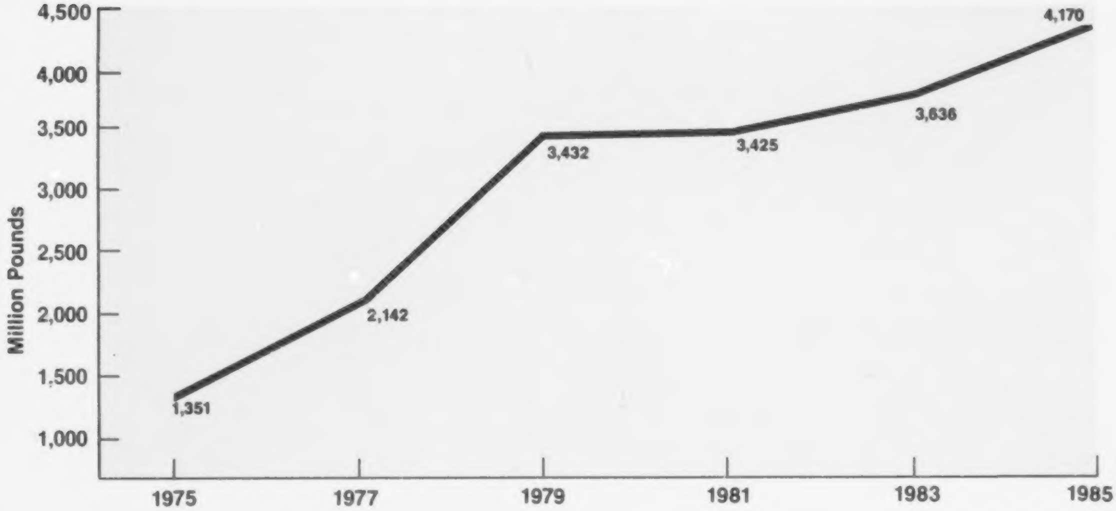


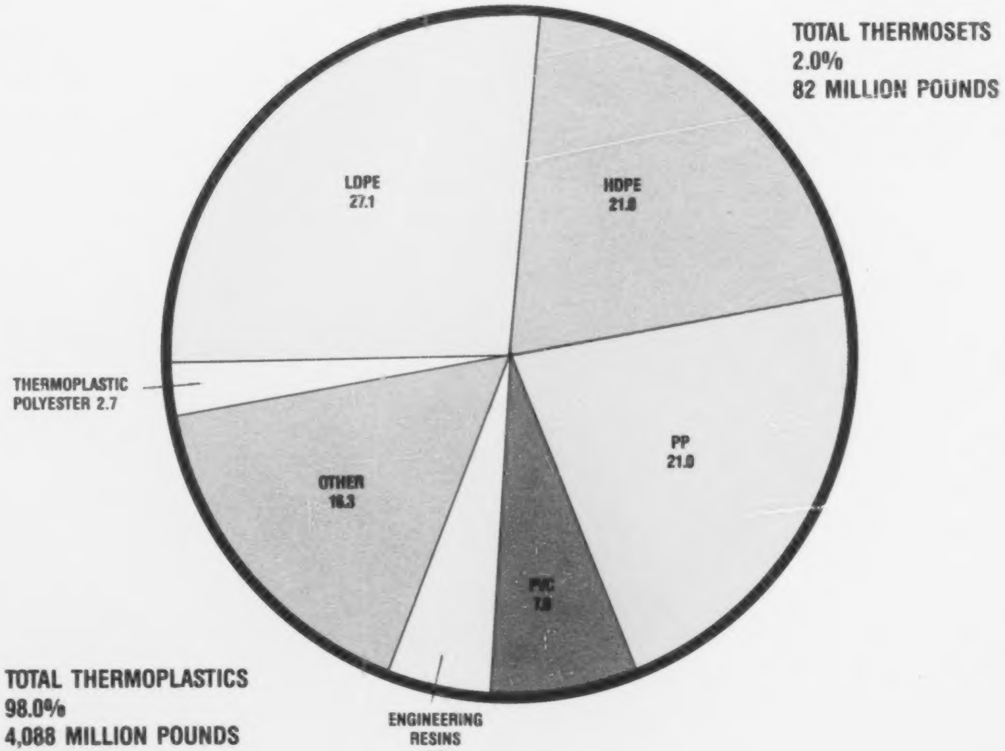
Million Pounds
3,800
3,400
3,000
2,600
2,200
1,800
1,400
1,000
600
200
1,906
2,006
2,471
2,793
3,416
1,353
1,226
1,165
1,287
1,706
Resellers & Compounders
Sales Unclassified
1981
1982
1983
1984
1985

ALL OTHER (cont'd.)



EXPORTS


4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
Million Pounds
1975
1977
1979
1981
1983
1985
1,351
2,142
3,432
3,425
3,636
4,170


TOTAL THERMOSETS
2.0%
82 MILLION POUNDS
LDPE
27.1
HDPE
21.0
PP
21.0
PVC
7.0
OTHER
16.3
THERMOPLASTIC
POLYESTER 2.7
ENGINEERING
RESINS
4.9
TOTAL THERMOPLASTICS
98.0%
4,088 MILLION POUNDS

APPENDIX A

Table of 1985 distribution of plastics resins sales
and use by Major Market, including market segments.

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.
1985 DISTRIBUTION OF PLASTIC RESINS SALES & USE *(CAPTIVE)* BY MAJOR MARKET
(In millions of pounds, dry weight basis) (1)

MAJOR MARKET	Total Thermosets		Total Thermoplastics		Grand Total	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	557	9.1	1,432	3.7	1,989	4.4
Motor Vehicles and Parts	248	4.0	1,343	3.4	1,591	3.5
Ships, Boats and Recreational Vehicles	265	4.4	30	0.1	295	0.7
All Other Transportation Equipment	44	0.7	59	0.2	103	0.2
PACKAGING, TOTAL	47	0.8	12,727	32.5	12,774	28.2
Bottles, Jars, Vials			2,137	5.5		
Food Containers (Excluding Disposable Cups)			2,228	5.7		
Flexible Packaging - *(Bags, Liners, Etc.)*			5,779	14.7		
Household and Institutional Refuse Bags & Film	–	–	2,968	6.9	2,698	6.0
All Other Flexible Packaging			3,081	7.8		
All Other Packaging	36	0.6	2,583	6.6	2,619	5.8
BUILDING AND CONSTRUCTION, TOTAL	3,485	56.8	6,553	16.7	10,038	22.1
Pipe, Conduit and Fittings	83	1.4	3,698	9.4	3,781	8.3
Building Materials for All Structures	2,640	43.0	1,907	4.9	4,547	10.0
Siding, Siding Accessories, and Structural Panels for Siding	737	12.0	443	1.2	1,180	2.6
Flooring	787	12.8	526	1.3	1,313	2.9
Insulation Material	592	9.7	414	1.1	1,006	2.2
All Other Building Materials for All Structures	524	8.5	524	1.3	1,048	2.3
All Other Building and Construction	762	12.4	948	2.4	1,710	3.8
ELECTRICAL/ELECTRONIC, TOTAL	351	5.7	2,308	5.9	2,659	5.9
Home and Industrial Appliances	88	1.4	741	1.9	829	1.8
Communications Equipment	9	0.2	100	0.3	109	0.3
Electric Equipment Combined with Electronic Components	254	4.1	425	1.1	679	1.5
Storage Batteries	–	–	135	0.3	135	0.3
Wire and Cable	–	–	907	2.3	907	2.0
FURNITURE AND FURNISHINGS, TOTAL	105	1.7	2,002	5.1	2,107	4.6
Rigid Furniture	100	1.6	219	0.5	319	0.7
Flexible Furniture			86	0.2		
Carpet and Carpet Components	–	–	1,122	2.9	1,122	2.5
Other Textiles and Furnishings			575	1.5		
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	205	3.3	3,770	9.6	3,975	8.8
Disposable Food Serviceware (Includes Disposable Cups)	101	1.6	991	2.5	1,092	2.4
Health Care and Medical Products	–	–	619	1.6	619	1.4
Toys and Sporting Goods	24	0.4	375	1.0	399	0.9
Hobby and Graphic Arts Supplies	7	0.1	380	1.0	387	0.9
All Other Consumer and Institutional Products	73	1.2	1,405	3.5	1,478	3.2
INDUSTRIAL/MACHINERY, TOTAL	35	0.6	329	0.8	364	0.8
ADHESIVES/INKS/COATINGS, TOTAL	715	11.7	1,427	3.6	2,142	4.7
Adhesives and Sealants	72	1.2	652	1.6	724	1.6
All Other Inks and Coatings	643	10.5	775	2.0	1,418	3.1
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	554	8.8	4,568	11.7	5,122	11.3
Resellers and Compounders	188	3.1	3,228	8.2	3,416	7.5
Sales Unclassified	366	5.7	1,340	3.5	1,706	3.8
EXPORTS, TOTAL	82	1.5	4,088	10.4	4,170	9.2
GRAND TOTAL	6,136	100.0	39,204	100.0	45,340	100.0

Note: page 2,3,4 tables do not add vertically or horizontally due to disclosure.

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

(1) Phenolic on gross weight basis

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.
1985 DISTRIBUTION OF PLASTIC RESINS SALES & USE *(CAPTIVE)* BY MAJOR MARKET
(In millions of pounds, dry weight basis) (1)

MAJOR MARKET	Epoxy		Polyester		Urea & Melamine		Phenolics		All Other Thermosets	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	D	D	411	33.3	D	D	124	4.7	D	D
Motor Vehicles and Parts			139	11.3						
Ships, Boats and Recreational Vehicles			247	20.0						
All Other Transportation Equipment			25	2.0						
PACKAGING, TOTAL	D	D	-	-	30	2.1	D	D	-	-
Bottles, Jars, Vials					-	-				
Food Containers (Excluding Disposable Cups)										
Flexible Packaging - *(Bags, Liners, Etc.)*										
Household and Institutional Refuse Bags & Film					-	-				
All Other Flexible Packaging										
All Other Packaging										
BUILDING AND CONSTRUCTION, TOTAL	39	10.6	487	39.5	1,009	72.2	1,950	73.9	-	-
Pipe, Conduit and Fittings			55	4.5						
Building Materials for All Structures	15	4.1	147	11.9						
Siding, Siding Accessories, and Structural Panels for Siding			57	4.6			679	25.7		
Flooring	12	3.1					308	11.7		
Insulation Material	-	-					579	21.9		
All Other Building Materials for All Structures			88	7.1						
All Other Building and Construction			285	23.1						
ELECTRICAL/ELECTRONIC, TOTAL	72	19.5	61	4.9	D	D	128	4.8	D	D
Home and Industrial Appliances			9	0.7			76	2.9		
Communications Equipment			1	0.0			6	0.2		
Electric Equipment Combined with Electronic Components			51	4.2			46	1.7		
Storage Batteries	-		-	-			-	-		
Wire and Cable	-		-	-			-	-		
FURNITURE AND FURNISHINGS, TOTAL	D	D	11	0.9	43	3.1	D	D	-	-
Rigid Furniture										
Flexible Furniture										
Carpet and Carpet Components			-	-						
Other Textiles and Furnishings										
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	D	D	60	4.9	116	8.3	D	D	D	D
Disposable Food Serviceware (Includes Disposable Cups)			-	-						
Health Care and Medical Products			-	-	-	-				
Toys and Sporting Goods			22	1.8	-	-				
Hobby and Graphic Arts Supplies			6	0.5	-	-				
All Other Consumer and Institutional Products			32	2.6						
INDUSTRIAL/MACHINERY, TOTAL	D	D	D	D	-	-	7	0.3	-	-
ADHESIVES/INKS/COATINGS, TOTAL	140	38.0	D	D	D	D	82	3.1	425	85.2
Adhesives and Sealants	19	5.2							-	-
All Other Inks and Coatings	121	32.8							425	85.1
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	39	10.8	D	D	# 116	7.3	247	9.4	D	D
Resellers and Compounders										
Sales Unclassified										
EXPORTS, TOTAL	42	11.5	9	0.7	# D	# D	21	0.8	10	2.1
GRAND TOTAL	367	100.0	1,233	100.0	1,397	100.0	2,640	100.0	499	100.0

page 2 (1) phenolic on a gross weight basis

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

= Urea & Melamine Exports included in All Other Sales

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1985 DISTRIBUTION OF PLASTIC RESINS SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	Low Density PE		High Density PE		Polypropylene		ABS & SAN		Polystyrene		Styrene Latex & OSBP	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	D	D	183	2.7	230	4.4	269	24.5	D	D	D	D
Motor Vehicles and Parts							260	23.6				
Ships, Boats and Recreational Vehicles												
All Other Transportation Equipment					-	-						
PACKAGING, TOTAL	5,469	62.2	3,355	50.4	1,000	18.9	D	D	1,292	31.5	D	D
Bottles, Jars, Vials	18	0.2	1,122	16.9	101	1.9			48	1.2		
Food Containers (Excluding Disposable Cups)	384	4.4	833	12.5	128	2.4			802	19.5		
Flexible Packaging - *(Bags, Liners, Etc.)*	4,402	50.1	402	6.0	419	7.9			148	3.6		
Household and Institutional Refuse Bags & Film	2,232	25.4	85	1.2	261	4.9			-	-		
All Other Flexible Packaging	2,170	24.7	317	4.8	158	3.0			148	3.6		
All Other Packaging	665	7.5	998	15.0	352	6.7			294	7.2		
BUILDING AND CONSTRUCTION, TOTAL	327	3.7	546	8.2	D	D	134	12.2	449	10.9	D	D
Pipe, Conduit and Fittings	48	0.5	493	7.4			122	11.1				
Building Materials for All Structures	129	1.5							416	10.1		
Siding, Siding Accessories, and Structural Panels for Siding	-	-					-	-	-	-		
Flooring	-	-	-	-			-	-	-	-		
Insulation Material							-	-	394	9.6		
All Other Building Materials for All Structures									22	0.5		
All Other Building and Construction	150	1.7										
ELECTRICAL/ELECTRONIC, TOTAL	403	4.6	153	2.3	273	5.2	241	21.9	309	7.5	D	D
Home and Industrial Appliances					120	2.3	206	18.7	267	6.5		
Communications Equipment												
Electric Equipment Combined with Electronic Components												
Storage Batteries	-	-			116	2.2						
Wire and Cable	334	3.8	138	2.1			-	-	-	-		
FURNITURE AND FURNISHINGS, TOTAL	37	0.4	46	1.0	1,119	21.2	D	D	47	1.1	327	30.8
Rigid Furniture											-	-
Flexible Furniture			-	-					-	-	-	-
Carpet and Carpet Components			-	-	729	13.8			-	-	297	28.0
Other Textiles and Furnishings					300	5.7					30	2.8
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	468	5.3	507	7.6	621	11.8	D	D	1,090	26.5	D	D
Disposable Food Serviceware (Includes Disposable Cups)	175	2.0	49	0.7	67	1.3			679	16.5		
Health Care and Medical Products	83	0.9			270	5.1			71	1.7		
Toys and Sporting Goods			90	1.4	29	0.5			156	3.8		
Hobby and Graphic Arts Supplies					14	0.3			30	0.7		
All Other Consumer and Institutional Products	163	1.9	314	4.7	241	4.6			154	3.8		
INDUSTRIAL/MACHINERY, TOTAL	D	D	141	2.1	11	0.2	D	D	D	D	D	D
ADHESIVES/INKS/COATINGS, TOTAL	111	1.3	-	-	D	D	-	-	D	D	337	31.8
Adhesives and Sealants											19	1.8
All Other Inks and Coatings									-	-	318	30.0
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	831	9.5	843	12.6	1,097	20.8	160	14.5	825	20.1	72	6.8
Resellers and Compounders	559	6.4	589	8.8	834	15.8			576	14.0		
Sales Unclassified	272	3.1	254	3.8	263	5.0			249	6.1		
EXPORTS, TOTAL	1,131	12.9	877	13.1	875	16.6	D	D	84	2.0	D	D
GRAND TOTAL	8,790	100.0	6,651	100.0	5,275	100.0	1,100	100.0	4,108	100.0	1,060	100.0

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1985 DISTRIBUTION OF PLASTIC RESINS SALES & USE *(CAPTIVE)* BY MAJOR MARKET

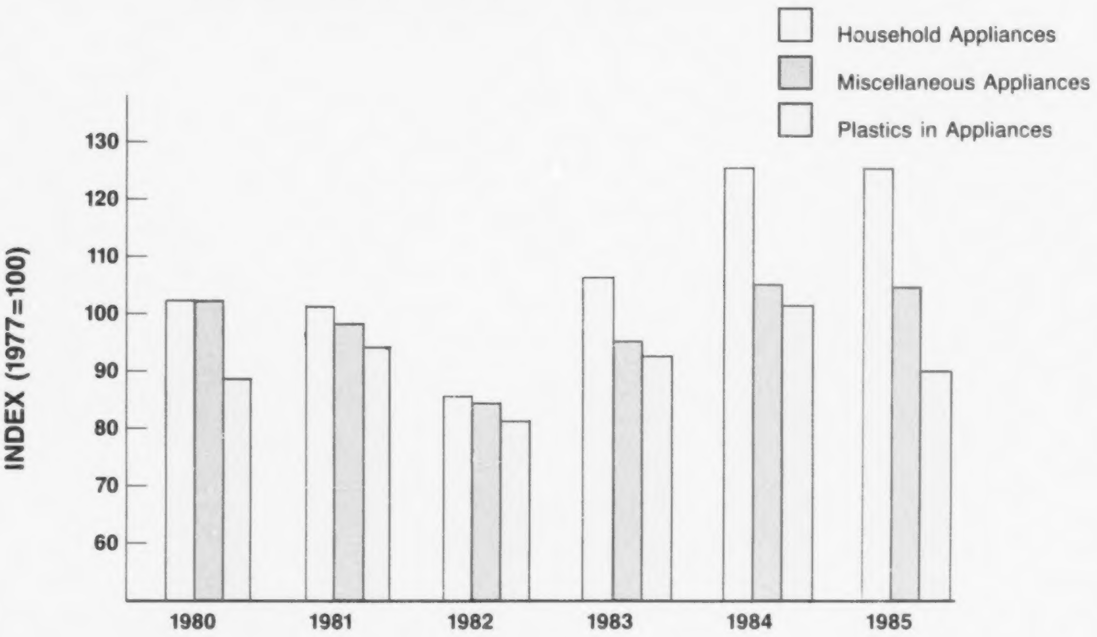
(In millions of pounds, dry weight basis)

MAJOR MARKET	Nylon		PVC		PVAc, PVOH, Other Vinyl		Thermoplastic Polyester		Engineering Resins		All Other Thermoplastic	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	180	44.8	141	2.1	D	D	63	6.6	D	D	110	4.8
Motor Vehicles and Parts	158	39.2	124	1.8							97	4.2
Ships, Boats and Recreational Vehicles							-	-				
All Other Transportation Equipment												
PACKAGING, TOTAL	D	D	572	8.5	D	D	702	73.5	14	1.6	123	5.4
Bottles, Jars, Vials			162	2.4			659	69.0			18	0.8
Food Containers (Excluding Disposable Cups)									-	-		
Flexible Packaging - *(Bags, Liners, Etc.)*			218	3.2					-	-	80	3.5
Household and Institutional Refuse Bags & Film			90	1.3					-	-	-	-
All Other Flexible Packaging			128	1.9					-	-	80	3.5
All Other Packaging												
BUILDING AND CONSTRUCTION, TOTAL	D	D	4,198	62.5	25	2.5	D	D	79	9.4	693	30.3
Pipe, Conduit and Fittings			3,014	44.9	-	-						
Building Materials for All Structures			875	13.0							317	13.8
Siding, Siding Accessories, and Structural Panels for Siding			435	6.5	-	-			-	-		
Flooring			297	4.4	-	-			-	-		
Insulation Material					-	-			-	-		
All Other Building Materials for All Structures											115	5.0
All Other Building and Construction			309	4.6								
ELECTRICAL/ELECTRONIC, TOTAL	67	16.5	479	7.1	D	D	D	D	250	29.8	93	4.1
Home and Industrial Appliances			24	0.4					82	9.8		
Communications Equipment												
Electric Equipment Combined with Electronic Components	** 36	8.9									77	3.4
Storage Batteries									-	-	-	-
Wire and Cable	21	5.2	393	5.8					-	-	-	-
FURNITURE AND FURNISHINGS, TOTAL	5	1.2	310	4.6	73	7.2	D	D	D	D	D	D
Rigid Furniture												
Flexible Furniture					-	-						
Carpet and Carpet Components			44	0.6								
Other Textiles and Furnishings			142	2.1	48	4.7						
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	D	D	230	3.4	57	5.6	D	D	28	3.3	540	23.6
Disposable Food Serviceware (Includes Disposable Cups)					-	-						
Health Care and Medical Products			55	0.8					20	2.4		
Toys and Sporting Goods			10	0.1	-	-						
Hobby and Graphic Arts Supplies									-	-	240	10.5
All Other Consumer and Institutional Products			155	2.3							273	11.9
INDUSTRIAL/MACHINERY, TOTAL	32	7.9	30	0.5	D	D	D	D	37	4.4	D	D
ADHESIVES/INKS/COATINGS, TOTAL	D	D	89	1.3	631	62.4	D	D	-	-	255	11.1
Adhesives and Sealants			35	0.5	300	29.7					255	11.1
All Other Inks and Coatings			54	0.8	331	32.7					-	-
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	28	6.9	379	5.6	21	2.1	10	1.0	81	9.6	221	9.7
Resellers and Compounders	25	6.2	238	3.5								
Sales Unclassified	3	0.7	141	2.1								
EXPORTS, TOTAL	24	6.0	292	4.4	84	8.3	114	11.9	203	24.2	221	9.7
GRAND TOTAL	403	100.0	6,720	100.0	1,012	100.0	956	100.0	839	100.0	2,290	100.0

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

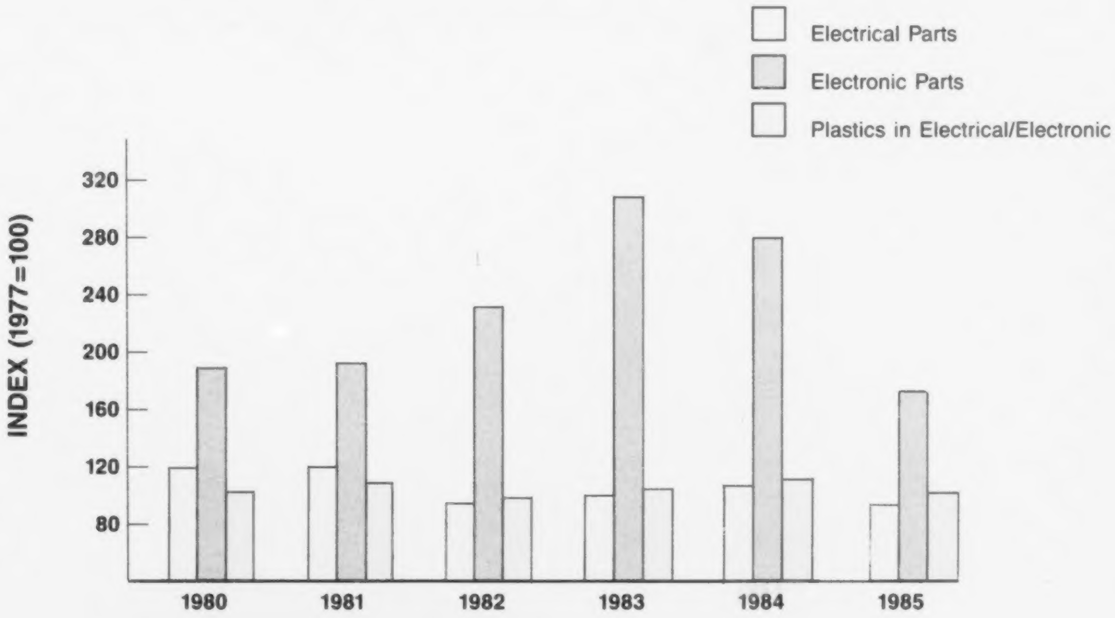
** = Includes Storage Batteries

PLASTICS IN APPLIANCES vs TOTAL APPLIANCES[1]



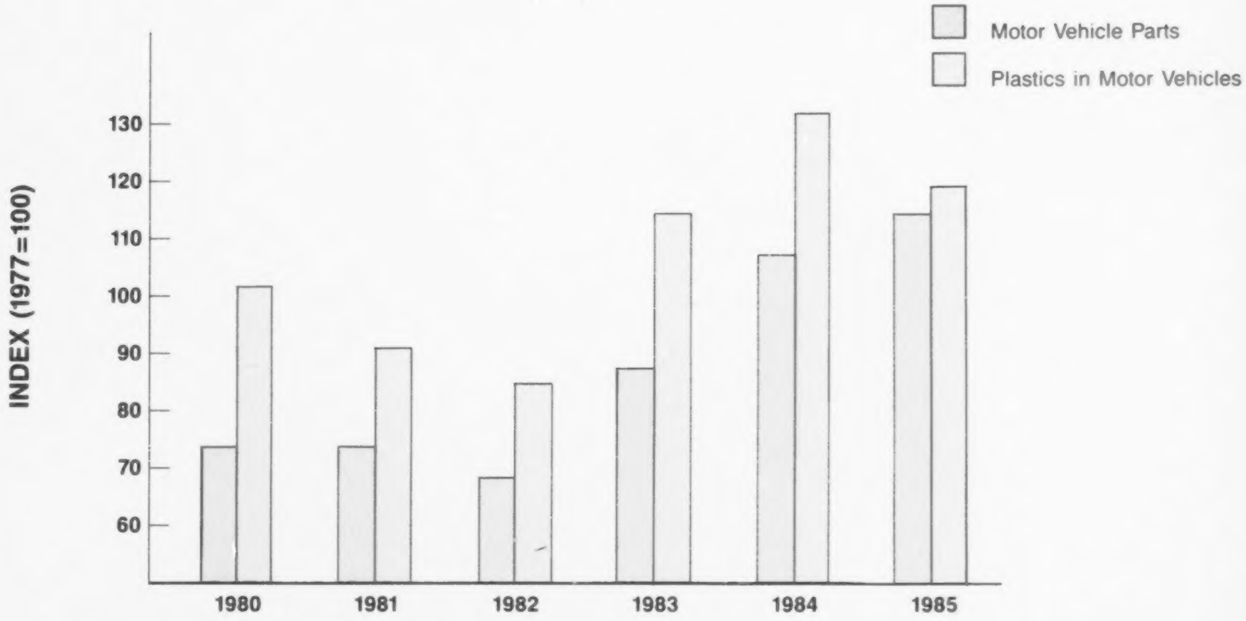
[1] Plastics Sales vs Appliance Industrial Production
Source: SPI
Modern Plastics Magazine
Survey of Current Business

PLASTICS IN ELECTRICAL/ELECTRONIC vs TOTAL ELECTRICAL/ELECTRONIC[1]



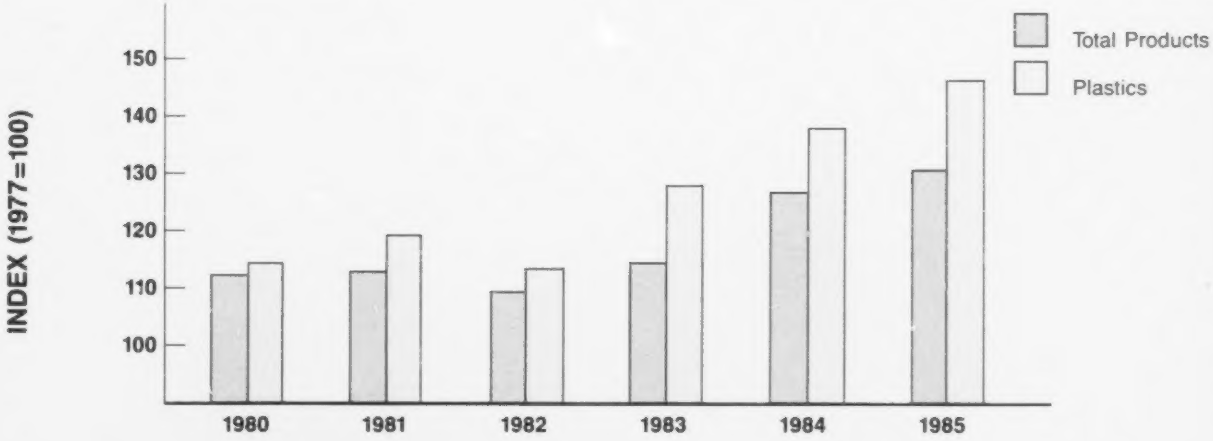
[1] Plastics Sales vs Electrical/Electronic Industrial Production
Source: SPI
Modern Plastics Magazine
Survey of Current Business

PLASTICS IN MOTOR VEHICLES vs TOTAL MOTOR VEHICLE PARTS[1]



[1] Plastics Sales vs Motor Vehicle Parts Industrial Production
Source: SPI
Modern Plastics Magazine
Survey of Current Business

PLASTICS CONSUMPTION vs TOTAL PRODUCTS[1]



[1] Plastics Sales vs Total Products Industrial Production
Source: SPI
Modern Plastics Magazine
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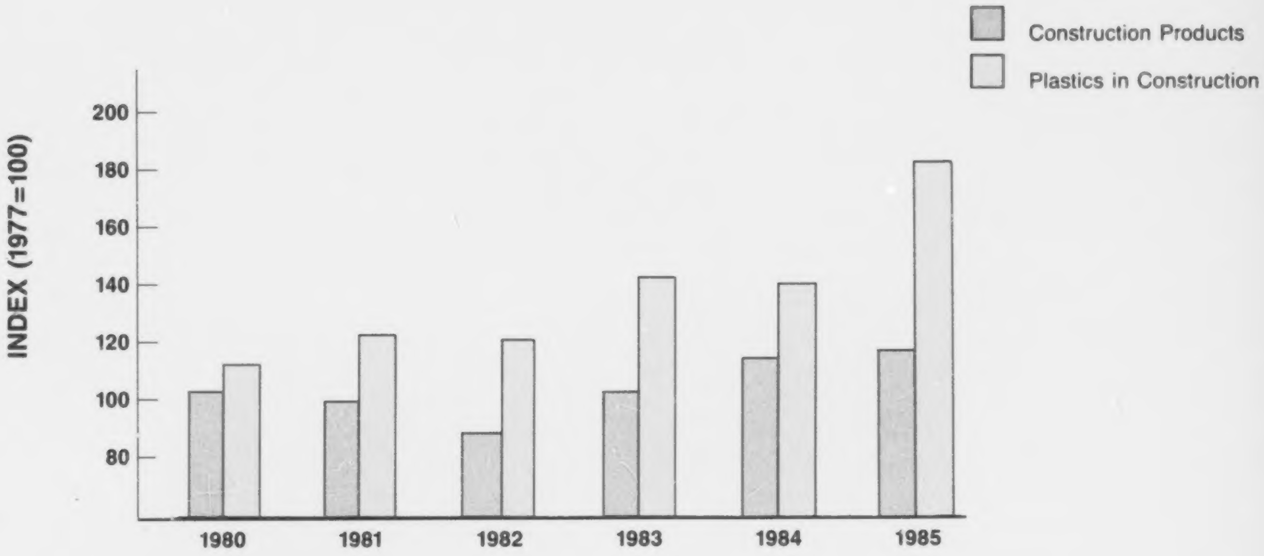
PLASTICS IN CONSTRUCTION vs TOTAL CONSTRUCTION PRODUCTS[1]



[1] Plastics Sales vs Construction Industrial Production

Source: SPI

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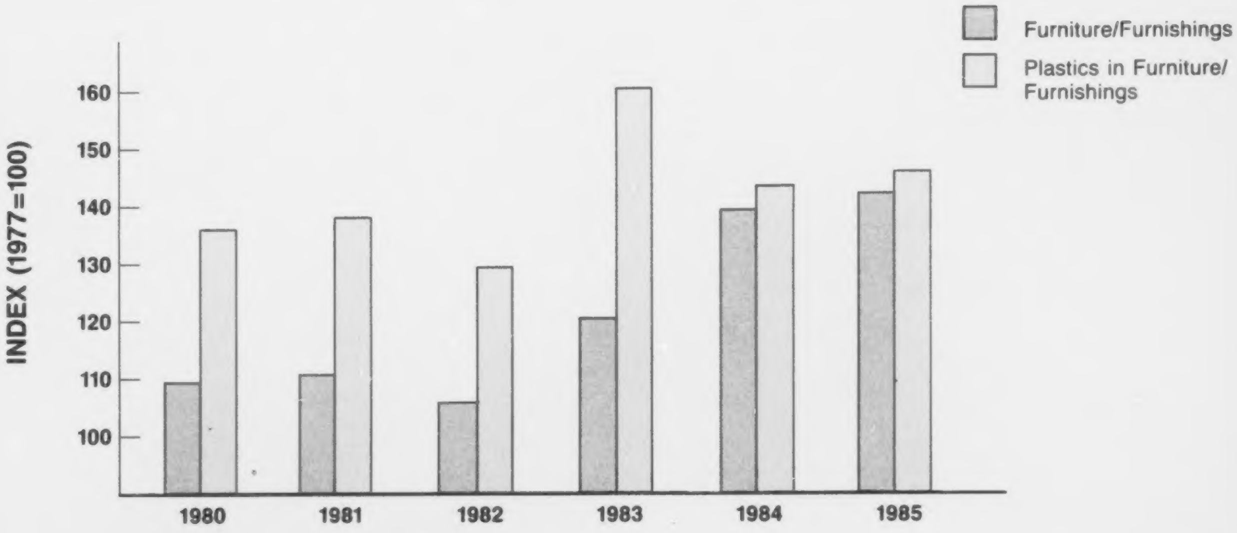
PLASTICS IN FURNITURE/FURNISHINGS vs TOTAL FURNITURE/FURNISHINGS[1]



[1] Plastics Sales vs Furniture Industrial Production

Source: SPI

Modern Plastics Magazine

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PROCESSING
&
MACHINERY

PROCESSING METHODS

INJECTION MOLDING

Injection molding is the principal method of forming thermoplastic materials. Modifications of the injection process are sometimes used for thermosetting plastics.

In injection molding, plastic material is put into a hopper which feeds into a heating chamber. A plunger pushes the plastic through this long heating chamber where the material is softened to a fluid state. At the end of this chamber there is a nozzle which abuts firmly against an opening into a cool, closed mold. The fluid plastic is forced at high pressure through this nozzle into the cold mold. As soon as the plastic cools to a solid state, the mold opens and the finished plastic is ejected from the press.

THe problem with injection molding of thermosetting materials is that, under heat, these plastics will first soften, then harden to an infusible state. Thus it is essential that no softened thermosetting material in the heating chamber be allowed to remain there long enough to set.

Jet molding, offset molding and molding using a screw-type machine overcome this problem by liquefying the thermosetting plastic material just as it goes through the injection nozzle into the mold, but not before.

BLOW MOLDING

Blow molding is a method of forming used with thermoplastic materials.

Basically, blow molding consists of stretching and then hardening a plastic against a mold. There are two general methods of doing this type of thermoplastic molding: the direct method and the indirect method, encompassing several variations of each.

In the direct method, a glob of molten thermoplastic material is formed into the rough shape of the desired finished product. This shape is then inserted in a female mold and air blown into the plastic, as into a balloon, to force it against the sides of the mold. The formed material is then cooled before removal from the mold.

In the indirect method, a thermoplastic sheet or special shape is first heated, then clamped between a die and cover. Air pressure forced between the plastic and the cover forces the material into contact with the die, which has the contour desired in the finished product. The plastic is cooled before removal from contact with the die.

COMPRESSION MOLDING

Compression molding is the most common method of forming thermosetting materials. It is not generally used for thermoplastics.

Compression molding is simply the squeezing of a material into a desired shape by application of heat and pressure to the material in a mold.

Plastic molding powder, mixed with such materials or fillers as woodflour, cellulose and asbestos to strengthen or give other added qualities to the finished product, is put directly into the open mold cavity. The mold is then closed, pressing down on the plaastic and causing it to flow throughout the mold. It is while the heated mold is closed that the thermosetting material undergoes a chemical change which permanently hardens it into the shape of the mold. The three compression molding factors—pressure, temperature and time mold is closed—vary with the design of the finished article and the material being molded.

EXTRUSION

Extrusion molding is the method employed to form thermoplastic materials into continuous sheeting, film, tubes, rods, profile shapes, filaments, and to coat wire, cable and cord.

In extrusion, dry plastic material is first loaded into a hopper, then fed into a long heating chamber through which it is moved by the action of a continuously revolving screw. At the end of the heating chamber the molten plastic is forced out through a small opening or die with the shape desired in the finished product. As the plastic extrusion comes from the die, it is fed onto a conveyor belt where it is cooled, most frequently by blowers or by immersion in water.

In the case of wire and cable coating, the thermoplastic is extruded around a continuing length of wire or cable which, like the plastic, passes through the extruder die. The coated wire is wound on drums after cooling.

In producing wide film or sheeting, the plastic is extruded in the form of a tube. This tube may be split as it comes from the die and then stretched and thinned to the dimensions desired in the finished film.

In a different process, the extruded tubing is inflated as it comes from the die, the degree of inflation of the tubing regulating the thickness of the final film.

THERMOFORMING

Thermoforming of plastic sheet has developed rapidly in recent years. Basically, this process consists of heating thermoplastic sheet to a formable plastic state and then applying air and/or mechanical assists to shape it to the contours of a mold.

Air pressure may range from almost zero to several hundred psi. Up to approximately 14 psi (atmospheric pressure), the pressure is obtained by evacuating the space between the sheet and the mold in order to utilize this atmospheric pressure. This range, known as *vacuum forming,* will give satisfactory reproduction of the mold configuration in the majority of forming applications.

TRANSFER MOLDING

Transfer molding is most generally used for thermosetting plastics.

This method is like compression molding in that the plastic is cured into an infusible state in a mold under heat and pressure. It differs from compression molding in that the plastic is heated to a point of plasticity before it reaches the mold and is forced into a closed mold by means of an hydraulically-operated plunger.

Transfer molding was developed to facilitate the molding of intricate products with small deep holes or numerous metal inserts. The dry molding compound used in compression molding sometimes disturbs the position of the metal inserts and the pins which form the holes. The liquefied plastic material in transfer molding flows around these metal parts without causing them to shift position.

REACTION INJECTION MOLDING

Reaction injection molding (RIM) is a relatively new processing technique that has rapidly taken its place alongside more traditional methods. Unlike liquid casting, the two liquid components, polyols and isocyanates, are mixed in a chamber at relatively low temperatures (75°-140°) before injection into a closed mold. An exothermic reaction occurs and consequently RIM requires far less energy usage than any other injection molding system.

The three major types of polyurethane RIM systems are rigid structural foam, low-modulus elastomers, and high-modulus elastomers.

Reinforced RIM (R-RIM) consists in the addition of such materials as chopped or milled glass fiber to the polyurethane to enhance stiffness and to increase modulus thus expanding the range of applications.

DOLLAR SALES OF PLASTICS MACHINERY

(in millions of dollars)

MACHINE TYPE	1981	1982	1983	1984[a]	1985
Injection Molding	311.2	225.0	298.0	457.0	376.0
Structural Foam	8.7	5.0	4.5	4.5	4.5
Extrusion, single screw	201.0	140.0	85.0	137.0	84.5
Extrusion, multi screw	23.3	19.0	18.5	22.0	16.0
Blow Molding	100.0	89.0	120.0	105.0	65.0
Thermoforming	32.0	28.0	33.0	44.0	50.0
Reaction-Injection Molding	7.8	6.0	8.0	10.0	7.5
Compression	24.4	17.5	17.0	16.5	13.0
Expanded Bead	15.5	5.0	8.0	8.0	1.0
Transfer Molding	8.0	6.0	5.5	5.5	4.5
Total	731.9	540.5	597.5	809.5	622.0

[a] Revised from 1985 edition.

Source: *Modern Plastics* Magazine

SHIPMENTS OF SINGLE SCREW EXTRUSION MACHINERY

(in number of units)

SCREW DIAMETER	1981	1982	1983	1984	1985
Up To But Not Including 2″	121	129	168	184	156
2″ Up To But Not Including 2½″	171	131	126	168	115
2½″ Up To But Not Including 3″	254	184	163	267	235
3″ Up To But Not Including 4″	182	148	165	198	216
4″ Up To But Not Including 5½″	196	127	85	181	140
5½″ Up To But Not Including 7½″	64	45	60	106	76
Includes 7½″ & Larger	21	8	5	12	16
Total	1,009	772	772	1,116	954

Note: Includes domestic shipments and exports

Source: SPI Machinery Division

SHIPMENTS OF INJECTION MOLDING MACHINERY

(in number of units)

CLAMP FORCE (Tons)	1981	1982	1983	1984	1985
Domestic Shipments					
0–199	838	683	848	1,239	a
200–299	433	d	363	485	1,316
300–399	453	253	b	484	411
400–499	325	276	b	f	b
500–599	d	89	543	f	280
600–749	d	83	f	f	f
750–1199	d	e	f	f	f
1200–1999	d	e	f	f	f
2000 and Over	—	—	106	402	246
Total	2,049	1,384	1,860	2,610	2,253
Export Shipments					
0–199	51	25	34	39	a
200–299	31	d	12	22	44
300–399	25	13	b	22	12
400–499	76	25	b	f	b
500–599	d	8	14	f	9
600–749	d	14	f	f	f
750–1199	d	e	f	f	f
1200–1999	d	e	f	f	f
2000 and Over	—	—	2	12	14
Total	183	85	62	95	79
Total Shipments					
0–199	889	708	882	1,278	a
200–299	464	d	375	507	1,360
300–399	478	266	b	506	423
400–499	401	301	b	f	b
500–599	d	97	557	f	289
600–749	d	97	f	f	f
750–1199	d	e	f	f	f
1200–1999	d	e	f	f	f
2000 and Over	—	—	108	414	260
Grand Total	2,232	1,469	1,922	2,705	2,332

[a] Combined with 200–299

[b] Combined with 500–599

[c] Combined with 100–199

[d] Combined with 400–499

[e] Combined with 600–749

[f] Combined with 2000 and over

Source: SPI Machinery Division

GLOSSARY OF SELECTED PLASTICS PROPERTIES

ABLATION — The degradation and decomposition of a material caused by high heat friction.

ABRASION RESISTANCE — Ability to resist surface wear.

AGING — The effect, on materials, of exposure to an environment for an interval of time.

ARC RESISTANCE — The total time in seconds that an intermittent arc may play across a plastic surface without rendering the surface conductive.

BLEEDING — The diffusion of color out of a plastic part into the surrounding surface of part.

BLOCKING — The adhesion between touching layers of plastic, such as that which may develop under pressure during storage or use.

BLOOM — A visible exudation or efflorescence on the surface of a plastic; bloom can be caused by lubricant, plasticizer, etc.

BRITTLE POINT — The highest temperature at which an elastomer fractures in a prescribed impact test procedure.

BRITTLE TEMPERATURE — The lowest temperature at which a plastic material withstands given conditions without failure.

BUCKLING — Crimping of the fibers in a composite material, often occurring in glass-reinforced thermosets due to resin shrinkage during cure.

BULK DENSITY — The density of a molding material in loose form (granular, nodular, etc.) expressed as a ratio of weight to volume.

BULK FACTOR — The ratio of the volume of a molding compound or powdered plastic to the volume of the solid piece produced from it.

COEFFICIENT OF EXPANSION — The fractional change in dimension of a material for a unit change in temperature.

COEFFICIENT OF FRICTION — A measure of the resistance to sliding of one surface in contact with another surface.

COEFFICIENT OF LINEAR EXPANSION — A measure of the change in dimension of an object caused by a change in temperature; specifically measured by the increase in length of an object per unit degree change in temperature.

COEFFICIENT OF THERMAL EXPANSION — The change in volume per unit volume produced by a one degree rise in temperature.

COMPRESSIVE STRENGTH — The ability of a material to resist a force that tends to crush.

CORROSION RESISTANCE — The ability of a material to withstand contact with ambient natural factors or those of a particular artificially created atmosphere.

CRACK — An actual separation of molded material, visible on opposite surfaces of the part, and extending through the thickness; a fracture.

CRAZING — Fine cracks which may extend in a network on or under the surface of a plastic material.

CREEP — The change in dimension of a plastic under load over a period of time, not including the initial instantaneous elastic deformation.

CROSS-LINKING — Applied to polymer molecules, the setting-up of chemical links between the molecular chains. When extensive, as in most thermosetting resins, cross-linking makes one infusible supermolecule of all the chains.

DEFLECTION TEMPERATURE UNDER LOAD — The temperature at which a simple beam has deflected a given amount under load (formerly called heat distortion temperature).

DEFORMATION — Any change of form or shape in a body; the linear change of dimension of a body in a given direction produced by the action of external forces.

DEGRADATION — A deleterious change in the chemical structure of a plastic.

DETERIORATION — A permanent change in the physical properties of a plastic evidenced by impairment of these properties.

DIMENSIONAL STABILITY — Ability of a plastic part to retain the precise shape to which it was molded, cast, or otherwise fabricated.

DISCOLORATION — Any change from an initial color possessed by a plastic; a lack of uniformity in color where color should be uniform over the whole area of a plastic object.

ELASTICITY — That property of plastics materials by virtue of which they tend to recover their original size and shape after deformation.

ELASTOMERIC — The property of a material which at room temperature can be stretched under low stress to at least twice its original length and, upon immediate release of the stress, will return with force to its approximate original length.

ELECTRICAL STRENGTH [DIELECTRIC STRENGTH] — That property of an insulating material which enables it to withstand electric stress; the highest electric stress which an insulating material can withstand for a specified time without the occurrence of electrical breakdown by any path through its bulk.

ELONGATION — Deformation caused by stretching; the fractional increase in length of a material stressed in tension.

ENVIRONMENTAL STRESS CRACKING — The susceptibility of a thermoplastic resin to crack or craze when in the presence of surface active agents or other environments.

EXTENSIBILITY — The ability of a material to extend or elongate upon application of sufficient force, expressed as a percent of the original length.

EXUDATION — The formation in liquid form of a plasticizer on the surface of a plasticized resin.

FADING — Any lightening of an initial color possessed by a plastic; measured by accelerating the process by subjecting the plastic to high intensity ultraviolet rays of approximately the same wave length as those found in sunlight.

FATIGUE — The failure or decay of mechanical properties after repeated applications of stress.

FLAMMABILITY — Measure of the extent to which a material will support combustion.

FLEX LIFE — The time of heat-aging that an insulating material can withstand before failure when bent around a specific radius (used to evaluate thermal endurance).

FLEXURAL STRENGTH — The resistance of a material to being broken by bending stresses.

FLOW MARKS — Wavy surface appearance of an object molded from thermoplastic resins, caused by improper flow of the resin into the mold.

GEL POINT — The stage at which a liquid begins to exhibit pseudoelastic properties. Also known as "gel time."

GLASS TRANSITION TEMPERATURE — The center of the temperature range in which a noncrystalline solid changes from being glass-brittle to being viscous.

GLOSS — Brightness or luster of a plastic resulting from a smooth surface.

HAZE — Cloudy appearance within, or on the surface of, a plastic.

HEAT DISTORTION POINT — The temperature at which a standard test bar deflects under a stated load.

HEAT RESISTANCE — The property or ability of plastics and elastomers to resist the deteriorating effects of elevated temperatures.

HYDROLYSIS — Chemical decomposition of a substance involving the addition of water.

HYDROPHILIC — Capable of absorbing water.

HYDROPHOBIC — Capable of repelling water.

HYDROSCOPIC — Capable of adsorbing and retaining atmospheric moisture.

IMPACT STRENGTH — The ability of a material to withstand shock loading.

LACK OF FILLOUT — An area, occurring usually at the edge of a laminated plastic, where the reinforcement has not been wetted with resin.

MELT INDEX — The amount in grams, of a thermoplastic resin which can be forced through a 0.0825 inch orifice when subjected to 2160 grams force in 10 minutes.

MELTING POINT — The temperature at which a resin changes from a solid to a liquid.

MELT STRENGTH — The strength of a plastic while in the molten state.

MIGRATION — The transfer of a material from a plastic body to other contacting solids.

MOISTURE ABSORPTION — The pick-up of water vapor from air by a material. It relates only to vapor withdrawn from the air by a material and must be distinguished from water absorption, which is the gain in weight due to the take-up of water by immersion.

MOTTLE — The desired or accidental mixture of colors or shades of a color giving more or less distinct or complicated patterns or specks, spots, or streaks of color; any irregular imperfections on the surface.

NECKING — The localized reduction in cross-section which may occur in a material under tensile stress.

OPALESCENCE — The limited clarity of vision through a sheet of transparent plastic at any angle, because of diffusion within or on the surface of the plastic.

OPTICAL DISTORTION — Any apparent alteration of the geometric pattern of an object when seen through a plastic or as a reflection from a plastic surface.

OXIDATION — The chemical reaction involving the process of combining with oxygen to form an oxide; the deterioration of an adhesive film due to atmospheric exposure; the breakdown of a hot melt adhesive due to prolonged heating and oxide formation.

PIT — Small regular or irregular crater in the surface of a plastic, usually with width approximately of the same order of magnitude as its depth.

PLASTICITY — A property of plastics which allows the material to be deformed continuously and permanently without rupture upon the application of a force that exceeds the yield value of the material. (The opposite of "elasticity.").

SHEARING — Breaking caused by the action of equal and opposed forces, located in the same plane.

SPECIFIC GRAVITY — The ratio of the weight of any volume of a substance to the weight of an equal volume of another substance taken as standard at a constant or stated temperature. Solids and liquids are usually compared.

SPECIFIC HEAT — The quantity of heat required to raise the temperature of a unit mass of a substance one (1) degree under specified conditions.

STRESS-CRACK — External or internal cracks in a plastic caused by tensile stresses less than that of its short-time mechanical strength.

SWEATING — Exudation of small drops of liquid, usually a plasticizer or softener, on the surface of a plastic part.

SWELL — A dimensional increase caused by exposure to liquids and/or vapors.

TEAR RESISTANCE — The force required to tear completely across a notched specimen tested according to prescribed procedures, expressed in pounds per inch of specimen thickness.

TENSILE STRENGTH OR STRESS — The maximum tensile load per unit area of original cross section, within the gage boundaries, sustained by the specimen during a tension test.

THERMAL CONDUCTIVITY — Ability of a material to conduct heat.

THERMOELASTICITY — Rubber-like elasticity exhibited by a rigid plastic and resulting from an increase of temperature.

THERMOPLASTICITY — The ability for material to be deformed without breaking with a relatively fast flow, when (at a suitable temperature) this material is properly stressed.

TUNNELING — A condition occurring in incompletely bonded laminates, characterized by release of longitudinal portions of the substrate and deformation of these portions to form tunnel-like structures.

VISCOSITY — The property of resistance to flow exhibited within the body of a material, expressed in terms of relationship between applied shearing stress and resulting rate of strain in shear.

WEATHERING — The exposure of plastics outdoors.

OTHER SOURCES OF PLASTICS INFORMATION

Business Consulting Groups and Publishers

Business Communications Co., Inc.—9 Viaduct Rd., Box 2070C, Stamford, CT 06907—203/325-2208
Chem Systems Inc.—303 S. Broadway, Tarrytown, NY 10591—914/631-2828
Eldib Engineering & Research, Inc.—613 Springfield Ave., Berkeley Heights, NJ 07922—201/464-2244
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R.M. Kossoff & Associates, Inc.—10 Rockefeller Plaza, New York, NY 10020—212/246-4035
Arthur D. Little, Inc.—25 Acorn Park, Cambridge, MA 02140—617/864-5770
Margolis Marketing & Research Co.—232 Madison Ave., Suite 905, New York, NY 10016—212/685-1278
Market Search, Inc.—P.O. Box 2886, Toledo, OH 43606—419/472-7656
Morton Research Corporation—28 Merrick Avenue, Merrick, NY 11566—516/378-1066
Noyes Data Corp.—Mill Road at Grand Ave., Park Ridge, NJ 07656—201/391-8484
Predicasts, Inc.—200 University Circle Research Center, 11001 Cedar Ave., Cleveland, OH 44106—216/795-3000
Peter Sherwood Associates, Inc.—20 Haarlem Ave., White Plains, NY 10603—914/761-3033
Skeist Laboratories, Inc.—112 Naylon Ave., Livingston, NJ 07039—201/994-1050
Springborn Group—10 Springborn Ctr., Enfield, CT 06082—203/749-8371
SRI International—333 Ravenswood Ave., Menlo Park, CA 94025—415/326-6200
The Target Group—1000 Harston Lane, Philadelphia, PA 19118—215/233-4083
Technomic Consultants, Inc.—100 Corporate North, Bannockburn, IL 60015—312/295-8900
Technomic Publishing Co.—851 New Holland Ave., Box 3535, Lancaster, PA 17604—717/291-5609

Government Publications

Annual Survey of Manufactures—Bureau of the Census
Census of Manufactures—Bureau of the Census
Current Industrial Reports—Bureau of the Census
Foreign Trade Reports: FT 135 (imports), FT 410 (exports)—Bureau of the Census
Guide to Census Bureau Data Files and Special Tabulations—Bureau of the Census
Guide to Foreign Trade Statistics—Bureau of the Census
Producer Price Indexes—Bureau of Labor Statistics
Standard Industrial Classification Manual—Office of Management and Budget
Statistical Abstract of the U.S.—Department of Commerce
Statistical Services of the U.S. Government—Office of Management and Budget
Synthetic Organic Chemicals—International Trade Commission
U.S. Industrial Outlook—Department of Commerce

Newspapers

Chemical Marketing Reporter—100 Church St., New York, NY 10007—212/732-9820
Journal of Commerce—110 Wall St., New York, NY 10005—212/425-1616
Rubber & Plastics News—1 Cascade Plaza, Suite 1Q02, Akron, OH 44308—216/836-9180

Trade Associations & Professional Organizations

American Chemical Society—1155 16th St. NW, Washington, D.C. 20036—202/872-4600
Chemical Data Inc.—2900 N. Loop West, Suite 830—Houston, TX 77092—713/683-3900
Chemical Manufacturers Assn.—2501 M St. NW, Washington, D.C. 20037—202/887-1100
Chemical Marketing Research Assn.—139 Chestnut Av., Staten Island, NY 10305—718/727-0550
Chemical Specialties Manufacturers Assn.—1001 Connecticut Ave., NW, Washington, D.C. 20036—202/872-8110
Composite Can & Tube Institute—1742 N St., NW, Washington, D.C. 20036—202/223-4840
Drug, Chemical & Allied Trades Assn.—42-40 Bell Blvd., Suite 604, Bayside, NY 11361—718/229-8891
Dry Color Manufacturers Assn.—Suite 202, 206 N. Washington St., P.O. Box 20839, Alexandria, VA 22314—703/684-4044
Flexible Packaging Assn.—Suite 500, 1090 Vermont Ave., NW, Washington, D.C. 20005—202/842-3880
INDA—1700 Broadway, New York, NY 10019—212/582-8401
International Institute of Synthetic Rubber Producers—2077 S. Gessner Rd., Suite 133, Houston, TX 77063—713/783-7511
International Isocyanate Institute—119 Cherry Hill Rd., Parsipanny, NJ 07054—201/263-7517
National Paint & Coatings Assn.—1500 Rhode Island Ave. NW, Washington, D.C. 20005—202/462-6272
Polyurethane Manufacturers Assn.—800 Roosevelt Rd., Bldg. C, Suite 20, Glen Ellyn, IL 60137—312/858-2670
Rubber Manufacturers Assn.—1400 K Street, NW, Washington, D.C. 20005—202/682-1338
Society of Plastics Engineers—14 Fairfield Drive, Brookfield Center, CT 06805—203/775-0471
Society of the Plastics Industry-Canada—1262 Don Mills Road, Suite 104, Don Mills, Ontario M3B2W7—416/449-3444
Synthetic Organic Chemical Manufacturers Assn.—1330 Connecticut Ave., N.W., Suite 300, Washington, D.C.—202/659-0060

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Canadian Plastics—1450 Don Mills Road, Ontario M3B2X7—416/445-6641
Chemical Engineering—1221 Ave. of the Americas, New York, NY 10020—212/997-2464
Chemical & Engineering News—1155 16th St., N.W., Washington, D.C. 20036—202/872-4600
Chemical Week—1221 Ave. of the Americas, New York, NY 10020—212/997-2922
Materials Engineering—Penton Plaza, Cleveland, OH 44114—216/696-7000
Modern Plastics—1221 Ave. of the Americas, New York, NY 10020—212/512-1221
Packaging Digest—201 East 42nd St., New York, NY 10017—212/867-9191
Plastics Compounding—1129 East 17th Ave., Denver, CO 80218—303/832-1022
Plastics Connection—P.O. Box 814, Amherst, MA 01004—413/549-5020
Plastics Design Forum—1129 East 17th Ave., Denver CO 80218—303/832-1022
Plastics Design & Processing—700 Peterson Rd., Libertyville, IL 60048—312/362-8711
Plastics Engineering—14 Fairfield Drive, Brookfield Center, CT 06805—203/775-0471
Plastics Industry News—1129 East 17th Ave., Denver, CO 80218—303/832-1022
Plastics Machinery & Equipment—1129 East 17th Ave., Denver, CO 80218—303/832-1022
Plastics Technology—633 Third Ave., New York, NY 10017—212/986-4800
Plastics World—275 Washington St., Newton, MA 02158—617/964-3030

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- HD Polyethylene
- Polypropylene
- ABS
- SAN
- Polystyrene
- Styrene Butadiene Latexes
- Other Styrene-based Latexes
- Other Styrene-based Polymers
- Nylon
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- Polyvinyl Acetate
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- Other Vinyl Resins
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MONTHLY STATISTICAL REPORT
THE SOCIETY OF THE PLASTICS INDUSTRY, INC.
(In thousands of pounds, dry weight basis)

THERMOSETTING RESINS

DECEMBER 1980

RESIN KIND & USE	SALES & CAPTIVE USE						PRODUCTION					
	DECEMBER			YEAR-TO-DATE			DECEMBER			YEAR-TO-DATE		
	1980	1979	% Change	1980	1979	% Change	1980	1979	% Change	1980	1979	% Change
EPOXY (UNMODIFIED) **RESINS, TOTAL**	30,709	25,639	+ 19.8	318,756R	331,970	− 4.0	26,491	24,829	+ 6.7	315,039R	361,077	− 12.8
Total Exports	3,732	3,496	+ 6.8	35,547	35,730	− 0.5						
Total Domestic	26,977	22,143	+ 12.8	283,209R	296,240	− 4.4						
Bonding & Adhesives	1,931	1,431	+ 34.9	17,742R	17,454	+ 1.7						
Flooring, Paving & Exposed Aggregate	1,886	1,481	+ 27.3	19,231R	19,583	− 1.8						
Protective Coatings	13,417	9,648	+ 39.1	137,308R	146,137	− 6.0						
Fiber Reinforced Laminates & Composites	5,164	4,785	+ 7.9	62,690R	60,268	+ 4.0						
Tooling, Casting & Molding Resins	2,749	2,417	+ 13.7	25,664R	30,940	− 17.1						
All Other Uses	1,830	2,381	− 23.1	20,574R	21,858	− 5.9						
POLYESTER (UNSATURATED) **RESINS, TOTAL**	75,749	76,020	− 0.4	921,169R	1,151,581	− 20.0	76,524	78,733	− 2.8	925,947R	1,147,174	− 19.3
General Purpose Resins							66,503	68,719	− 3.2	805,583R	1,010,750	− 20.3
Fire Retardant Resins							2,757	2,550	+ 8.1	28,739	32,035	− 10.3
Chemical Resistant Resins							7,264	7,464	− 2.7	91,625R	104,389	− 12.2
Isophthalic Resins							3,830	4,917	− 22.1	52,437R	63,158	− 17.0
All Other Resins							3,434	2,547	+ 34.8	39,188R	41,231	− 5.0
Total Exports	903	841	+ 7.4	11,254	14,250	− 22.5						
Total Domestic	74,846	75,179	− 0.4	909,915R	1,137,061	− 20.0						
Reinforced Plastics, Total	59,069	58,428	+ 1.1	709,229R	905,949	− 21.7						
Non-Reinforced Plastics, Total	15,777	16,751	− 5.8	200,686R	231,112	− 13.2						
LOW-DENSITY POLYETHYLENE 0.940 & BELOW, TOTAL	719,992	666,312	+ 8.1	7,467,465R	7,814,845	− 4.4	675,113	650,391	+ 3.8	7,290,727R	7,793,223	− 6.4
Total Exports	109,576	65,000	+ 68.6	1,147,442R	897,575	+ 27.8						
Total Domestic	610,416	65,000	+ 68.6	1,147,442R	897,575	+ 27.8						
Film (12 Mils & Below)	610,416	601,312	+ 1.5	6,320,023R	6,917,270	− 8.6						
Sheet (Over 12 Mils)	392,242	383,360	+ 2.3	4,003,749	4,363,250	− 8.2						
Injection Molding	921	1,930	− 52.3	18,176	25,825	− 29.6						
Wire & Cable	46,555	57,100	− 18.5	519,294R	649,975	− 20.1						
Extrusion Coating	20,042	34,572	− 42.0	335,403	424,139	− 20.9						
Blow Molding	44,772	41,001	+ 9.2	517,406R	539,098	− 4.0						
Pipe & Conduit	5,129	4,786	+ 7.2	65,453R	59,524	+ 10.0						
Other Extruded Products	2,660	2,293	+ 16.0	21,768R	32,718	− 33.5						
All Other Uses	4,244	5,140	− 17.4	56,018R	79,614	− 29.6						
HIGH-DENSITY POLYETHYLENE ABOVE 0.940, TOTAL	93,851	71,130	+ 31.9	782,756R	743,127	+ 5.3						
Total Exports	413,377	394,243	+ 4.9	4,393,038R	4,893,243	− 10.2	407,174	419,864	− 3.0	4,405,021	5,009,839	− 12.1
Total Domestic	61,114	54,188	+ 12.8	526,438R	608,654	− 13.5						
Film (12 Mils & Below)	352,263	340,055	+ 3.6	3,866,600	4,284,589	− 9.8						
Sheet (Over 12 Mils)	21,622	14,714	+ 46.9	201,086	212,399	− 5.3						
Injection Molding	7,921	4,541	+ 74.4	54,937	65,520	− 16.2						
Wire & Cable	89,601	84,541	+ 6.0	937,964	1,073,724	− 12.6						
Extrusion Coating	6,285	7,074	− 11.2	105,555	125,921	− 16.2						
Blow Molding	3,213	2,038	+ 57.7	27,565	30,242	− 8.9						
Pipe & Conduit	138,168	139,521	− 1.0	1,573,140	1,724,076	− 8.8						
Other Extruded Products	30,468	25,135	+ 21.2	368,352	400,395	− 8.0						
All Other Uses	1,703	2,120	− 19.7	24,250	18,931	+ 28.1						
	53,282	60,371	− 11.7	573,751	633,381	− 9.4						